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The International Journal of Orthodontia, Oral Surgery and Radiography

A Monthly Journal Devoted to the Advancement of the Sciences of Orthodontia, Oral Surgery, and Dental and Oral Radiography

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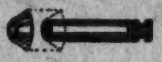

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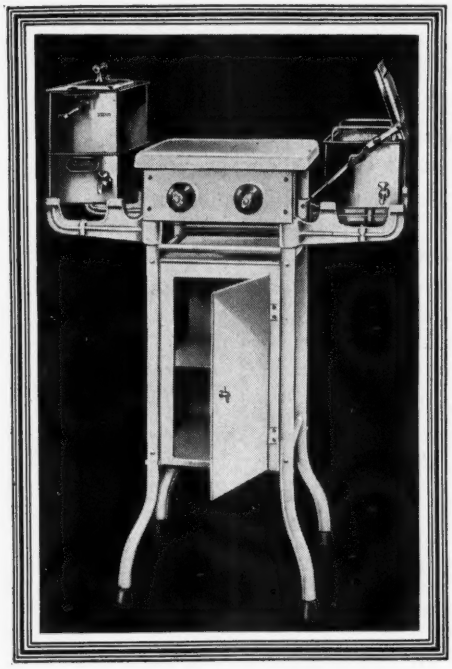

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The International Journal of
Orthodontia, Oral Surgery and Radiography
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VOL. VIII ST. LOUIS, MAY, 1922 NO. 5

ORIGINAL ARTICLES

THE INFLUENCE OF THE FORCES OF OCCLUSION ON THE DEVELOPMENT OF THE BONES OF THE SKULL*

BY LAWRENCE W. BAKER, D.M.D.
Assistant Professor of Orthodontia, Harvard Dental School, Boston, Mass.

TO PROVE a biologic law requires much patient labor, and indeed even to put on a firm foundation a single physiologic fact, as I am attempting to do in this series of investigations, is necessarily a long, slow process involving many painstaking experiments, as well as many collateral observations. As a matter of fact it was in 1909 that I began my initial experiment, and from that time up to the present I have been constantly at work either experimenting or collecting data; and although I have brought some interesting facts to light, still I am forced to admit I have not compassed the subject. The deeper I go into the work the more its complexities are appreciated, and I am mindful of the many influences operating both from within as well as from without which contribute in the development of the skull. Furthermore, the relationship between the function of the dental apparatus and the skull form in the various groups of lower animals as well as in the various types and races of man is a most intricate and difficult subject to investigate. But it is the encouragement that I am receiving from eminent anthropologists and the interest shown by my co-workers that keep me at the task.

It might be added in these introductory remarks, it was my intention at this time of giving only a short account of my latest unpublished experiments,

*Read before the American Society of Orthodontists, Atlantic City, New Jersey, April 27-30, 1921.
From the Research Department of the Harvard University Dental School.

I wish to express thanks for the invaluable aid given by Prof. Walter B. Cannon during these experiments, and for the use of the Physiological Laboratory of the Harvard Medical School, and to Prof. Harvey Cushing for the use of the Surgical Laboratory, and for helpful suggestions; also to Prof. Reid Hunt for the use of his laboratory and his skilled assistant.

but as the editor, Dr. Dewey points out, since my last published report of this work, which was before the Panama-Pacific Dental Congress in 1915, many young men have entered our ranks, and for the benefit of this younger element he has urged me to give a more complete report. I have yielded to his request and am therefore giving this more extended account, which includes an outline of my working theory, the salient facts regarding the earlier experiments added to my later experiments, so that the reader may trace the progress of my work from the beginning.

When the newborn babe enters this world, the muscles of mastication are

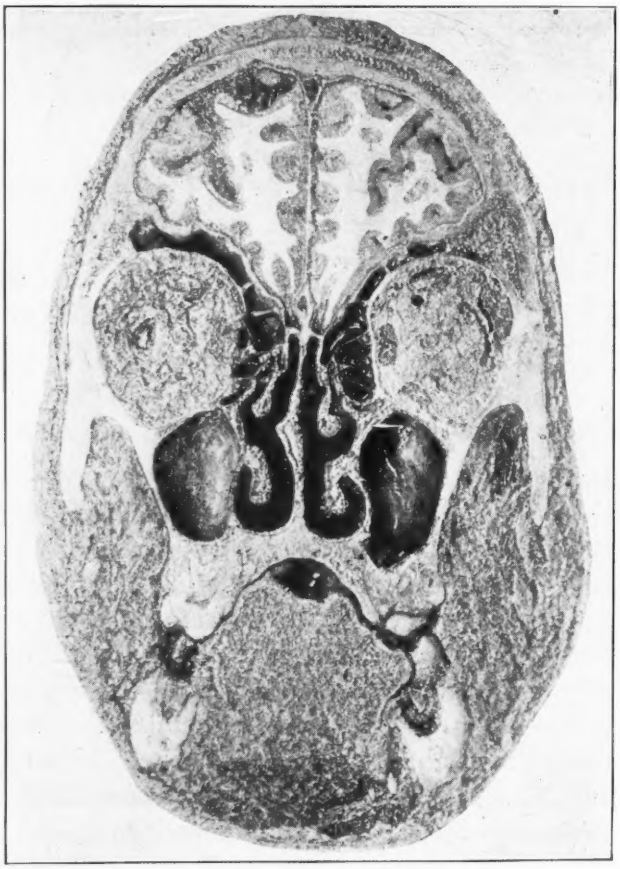


Fig. 1.—(After Cryer.) Transverse section through the human head in the molar region. Note the size of the masseter muscles and the extent to which they pull on the outer walls of the antrums and on the floors of the orbits.

among the first group of voluntary muscles to act. Their action means life, for it is by their function that nutrition is taken in. Long before the infant can hold up its head, or has gained control over those useful organs, the hands, the muscles of mastication are highly developed and are used with great vigor.

During the act of nursing, the action of this set of muscles is so vigorous that it demands an increased blood supply, to the extent that the heart action is greatly increased; the excessive flow of blood to these parts is indicated by a reddening of the whole head, and the fontanelles themselves are caused to

pulsate, so that untrained observers comment on their movement. Later, with the advent of the dental equipment, this group of muscles is given more leverage, and its action becomes consequently more powerful; in fact, the force exerted on the bones of the head from the pull of these muscles during life is tremendous and amounts to many hundreds of thousands of tons of force. I have long been convinced that this great force on the skull, and the great flow of arterial blood to the head, caused by this muscular activity, is a

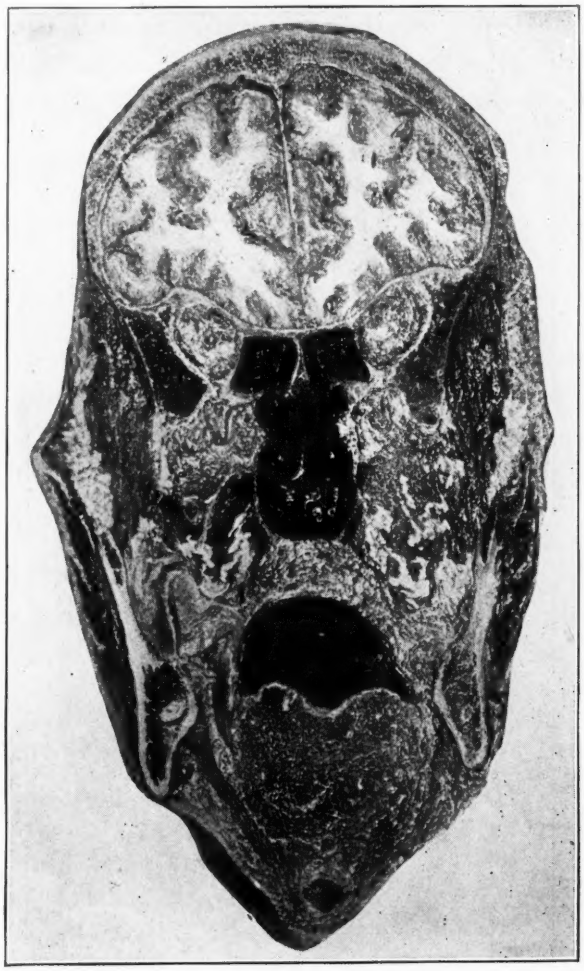


Fig. 2.—(After Cryer.) Transverse section through the human head in the region of the ascending rami of the lower jaw. Note the extent to which the muscles of mastication pull on the outer walls of the nasal cavities and the close proximity of the attachment of the temporal muscles to the brain.

powerful influence in the development of the bones of the head and the important organs incased therein. It is the object of my researches to throw some light on this important, but generally overlooked subject.

As this work is so intimately connected with the action of the muscles of mastication, it will be well to consider first a few facts pertaining to the general action of this group of muscles.

These muscles to a large extent surround the cranium, extending as they do from the temporal ridge on one side to the temporal ridge on the other side,

and the internal muscles of mastication are attached surprisingly close to the base of the brain. All this is shown in Figs. 1, 2 and 3.

It will also be observed from these illustrations that these muscles are attached to the skull, and inserted into the mandible at many different places and in many different ways, so that they pull in as many different directions, but it is a singular fact that, varied as are these muscles in shape, size, power and action, they have one common function, the dental equipment. The teeth may be almost termed the fulcrum of this group of muscles, because it is only when the teeth are brought together forcibly, or come in contact with food in mastication, that the great power of these muscles is brought out. The truth of this statement can be tested by slowly bringing the teeth together. It

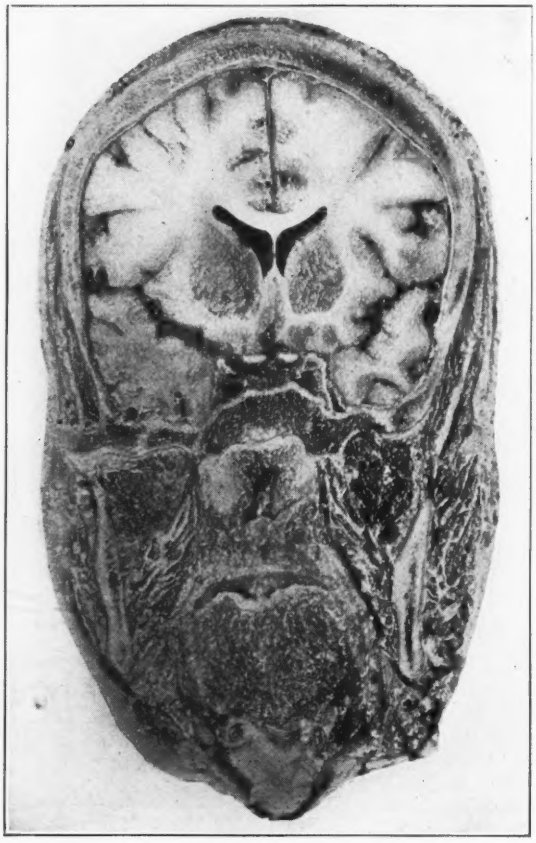


Fig. 3.—(After Cryer.) Transverse section through the human head further back than in Fig. 2. Note—1, that the muscles of mastication attach to the base of the brain-case; 2, compare the size of this muscular mass to the brain itself; 3, note the outward pull on the nasopharynx of both the external and internal pterygoid muscles.

will be noted that, while the mandible is swinging freely, the muscular action is almost passive, but the instant the teeth are brought into action, the muscles on the sides of the head and face will be seen to knot out and contract with great vigor, and, of course, the hidden powerful internal muscles do the same.

The resultant forces of these muscles are in reality the forces of occlusion, with which the members of this Society are so notably familiar. We well know that the forces of occlusion are based on definite laws, and it was the

early recognition of these laws by us, and our application of these laws to orthodontia, that has placed our specialty in such an eminent position.

The experiments on which this paper is based and those which I have at present under way, make me believe that the reaction of these occlusal forces on the skull are based on as definite laws as are the forces of occlusion themselves; furthermore, I believe that in these reactions are locked some of the secrets of a normal skull; for, if a group of forces acts in accordance with laws, why should not the reactions of these forces be governed by just as definite laws as are the forces themselves?

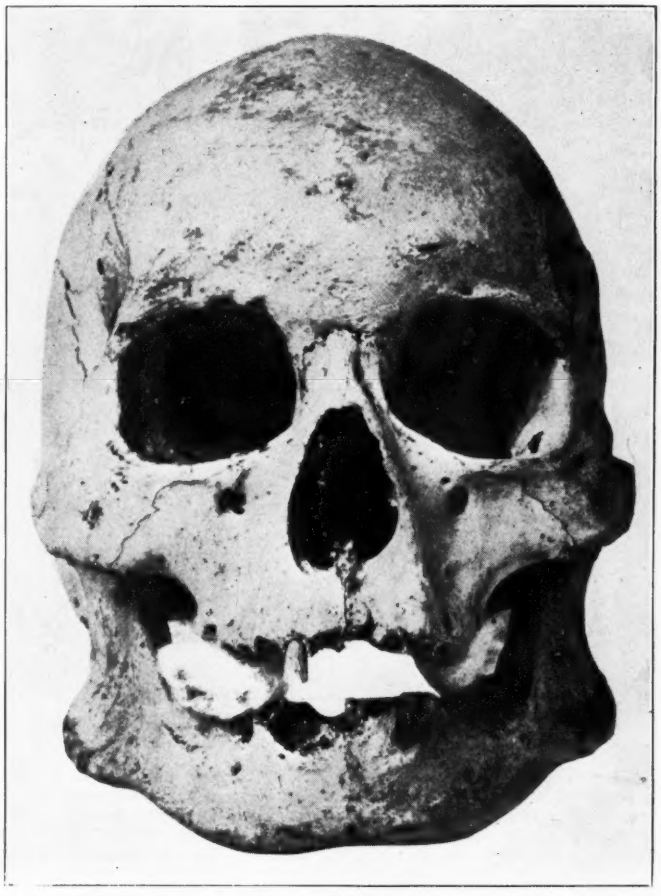


Fig. 4.—Skull of Eskimo. Observe the great facial breadth due to excessive mastication. (After Hrdlicker, Am. Mus. of Nat. Hist.)

Before leaving the first three illustrations, there are several other matters worthy of consideration; for example, note the area of this muscular mass (including the tongue) as compared with the whole head. It will be observed that it ranks well in size with the other structures or organs of this most compact, intricate and wonderful part of the human body. It is evident to me that Nature never would have devoted so much important space to this group of muscles, if it were not for the benefit of the head as a whole. According to the laws of evolution, the functional activity of such a mass of

muscular tissue cannot but have a direct and powerful influence in shaping the bones to which they are attached.*

Furthermore, the great supply of pure blood that the vigorous activity of these muscles demands not only rushes to these muscles, but also to other parts of the head, and it seems no more than logical to believe that the brain itself shares in this increased blood supply. The idea of muscular activity

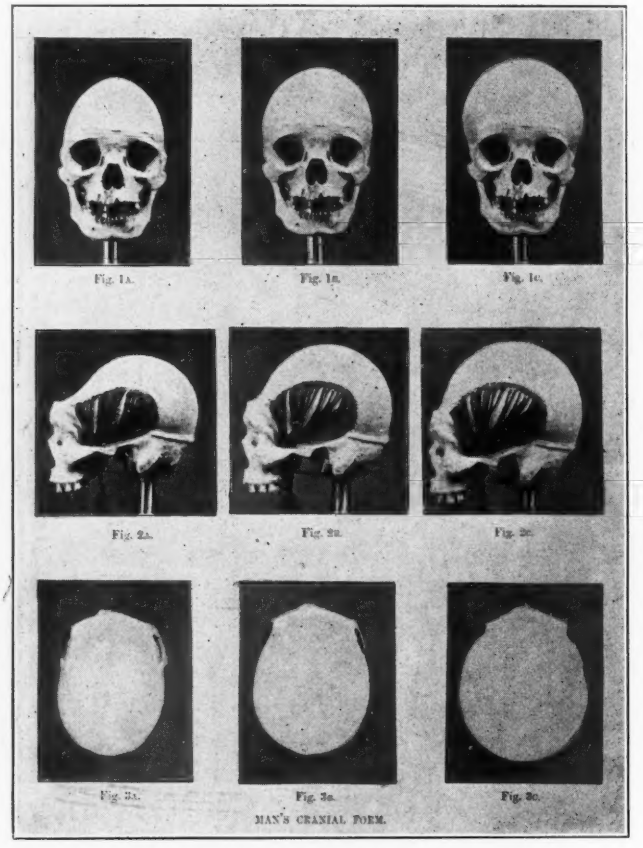


Fig. 5.—(After Prof. Arthur Thompson.)

*Figs. 4, 5 and 6, are illustrations of the effect of the use and disuse of the muscles of mastication on the human skull. Fig. 4 is the skull of a Southampton Eskimo (From Am. Mus. Nat. Hist. Anthropological Papers, N. Y., 1910, Vol. V.). Observe the great facial breadth, with its correspondingly broad and massive mandible. A. Hrdlicka states ("Contribution to the Anthropology of Central and Smith Sound Eskimo", Am. Mus. of Nat. Hist., Vol. V, Pt. 2 Anthropological Papers) that their great development is typical of the Eskimo and is due primarily to the excessive mastication which their tough food requires. H. Whitney states in his work "Hunting with the Eskimo", that it is probable no other race of man has a masticatory equipment powerful enough to perform the great work necessary in the struggle for life in that barren region. Fridtjof Nansen, in his "Eskimo Life", also gives a very interesting account of the excessive use of the teeth in their diet and in preparing hides for domestic purposes; and Dr. E. A. Hooton, Professor of Anthropology, Harvard University, has pointed out to me that in the Eskimo this excessive use of the teeth has brought about a disharmonic type of skull form.

Fig. 5 from "A Consideration of the More Important Factors Concerned in the Production of Cranial Form", by Prof. Arthur Thompson, Jour. Anthropological Inst., xxiii, N. S. vi, 1903, is here introduced to show that anatomists recognize the influence of the muscles of mastication as a factor in determining skull form. The illustration shows an ingenious experiment performed by Dr. Thompson in which he removed the top of the brain-case from a human skull and cleverly inserted an elastic rubber bladder to which were attached artificial muscles made of silken cords. By inflating the bladder to various degrees of tension, and by exerting pressure on it by means of the artificial muscles, he was able to demonstrate the various typal skull forms found in man, as may be observed.

Fig. 6 shows the effect of lack of use. The exceedingly poorly developed mandible is caused by the ankylosis of the temporo-mandibular articulation. This unfortunate deformity is typical of this condition when it occurs early in life. (See "Anthroplasty for Intra-Articular Bony and Fibrous Ankylosis of Temporo-mandibular Articulation" by John B. Murphy, M.D., LL.D., from the Jour. Am. Med. Assn., June 4, 1914, Vol. lxii, pp. 1783-1794.)

and increased circulation to the adjacent parts is a well-known fact. Dr. Campbell, in his remarkable series of papers* laid great emphasis on this matter.

It occurred to me that if my hypothesis regarding the influence of the dental equipment on the formation of the bones of the head were correct, interference with the laws of occlusion in the lower animals would show consequent effects in the formation of the bones of the skull; and if variation occurred, it might throw some light on the most complex problem of the development of the human head.

To test this theory, the following experiment was performed: A litter of four rabbits was selected at the age of weaning. One of the rabbits was chlo-

Fig. 6.—Lack of growth of mandible, due to ankylosis of temporo-maxillary articulation. (After John B. Murphy, M.D.)

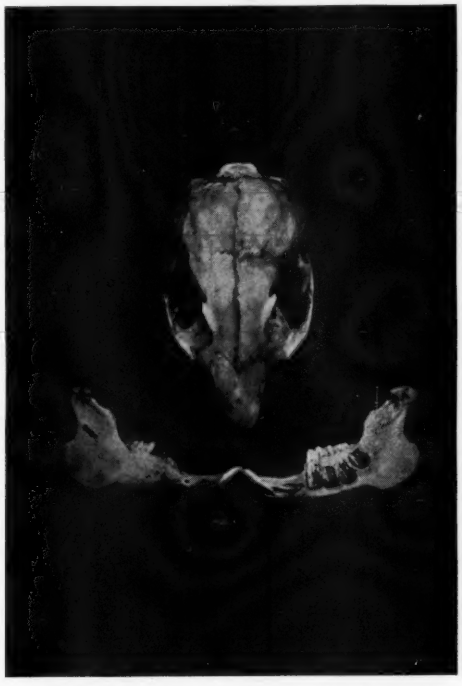


Fig. 7.—Skull of a young rabbit showing the state of development at the beginning of the experiment.

roformed, and the skull procured is shown in Fig. 7. Two of the remaining animals were operated on by grinding down all the teeth on the right side of the mandible and the maxillary right central incisor. As the teeth elongated, repeated grinding rendered them useless, so that all the mastication was performed on the left side. The fourth rabbit was kept in the normal state for the standard of comparison.

After seven months, the skeleton of one of the rabbits was procured and the skull was found to vary as is shown in Fig. 8 which is a photograph of its upper aspect. It will be noted, by the drawn lines, that there is a deviation of the bones to the left.† The suture between the parietal and frontal bones

*"Observations on Mastication", London, Lancet, July 11, 1903, "The Influence of the Contraction of the masticatory muscles on the Local Circulation of Blood and Lymph."

†Right and left in this description refer to the right and left sides of the animal. (The photographs are reduced in size).

does not run strictly at right angles to the longitudinal axis of the skull; the right frontal bone projects further forward than the left one. It will also be observed that the left zygomatic space is longer and more advanced than the right space. The most noticeable deviation is in the nasal bones, both being twisted to the left.

On the lower aspect of the skull (Fig. 9), it will be seen that the deviation extends throughout the entire skull.* The most remarkable deviation is that the anterior root of the right zygomatic arch (the zygomatic process of the maxillary bone) is retreated, while the body of the right maxillary bone itself, with the teeth that it contains, is greatly advanced.

Figs. 12 and 13 show that the mandible, as might be expected, is also dis-

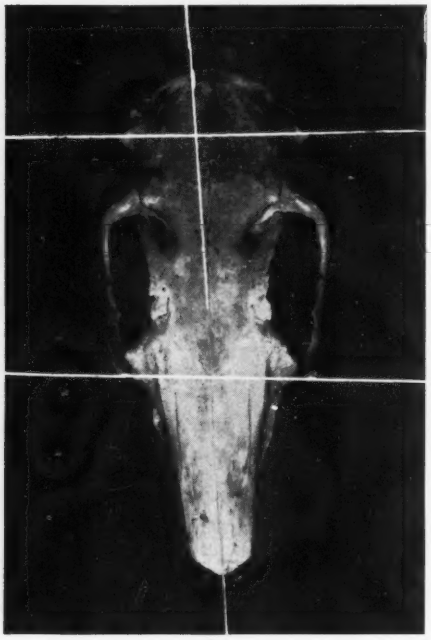


Fig. 8.—The upper aspect of a skull of an operated-on rabbit. Observe the unequal development of each lateral half of the skull.

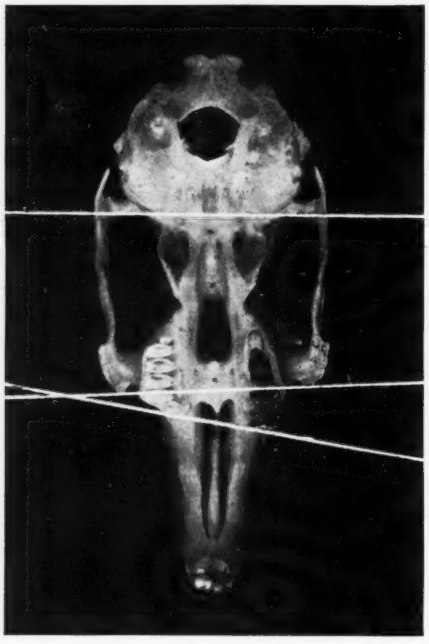


Fig. 9.—Lower aspect of Fig. 8.

torted, even to the size of the articular processes of the condyles (see Fig. 12). The one on the left, or working side, is perceptibly larger than the right. (Compare with normal mandible, Fig. 14.)

Three weeks later, autopsies were performed upon the second altered rabbit and on the "control" animal. In dissecting out the muscles that control the movements of the mandible, I was struck with the unequal muscular development of each lateral half of the altered animal. On the unused side the muscles were noticeably atrophied, and pale in color, as compared with the working side. Later, the skulls were weighed and both the worked-on

*Contrast Figs. 8 and 9 with 10 and 11, which are the same views of the skull of the control animal.

skulls weighed much less than the normal skull, showing that evidently the interference had affected the general osseous development of the head.*

Figs. 15 and 16 show the upper and lower aspects of the skull of the second altered rabbit. It will be noted that it varies in a similar way to the first one.

Fig. 17 shows the anterior aspect of the mandibles of the animals operated upon and the same view of the control animal. The method of interference with the occlusal equilibrium is plainly visible, and it is also evident that this interference with the equilibrium of occlusion has had its tangible influence on the equilibrium of growth of the bones. In both mandibles *a* and *c*, of the operated-on animals there is a striking similarity of deformity. In both cases the ramus of the nonfunctioning side is shortened, and there is even a modification in the development of the temporomandibular articulation on this

Fig. 10.—The upper aspect of the skull of a normal rabbit of the same litter. Observe the normal development of each lateral half of the skull.

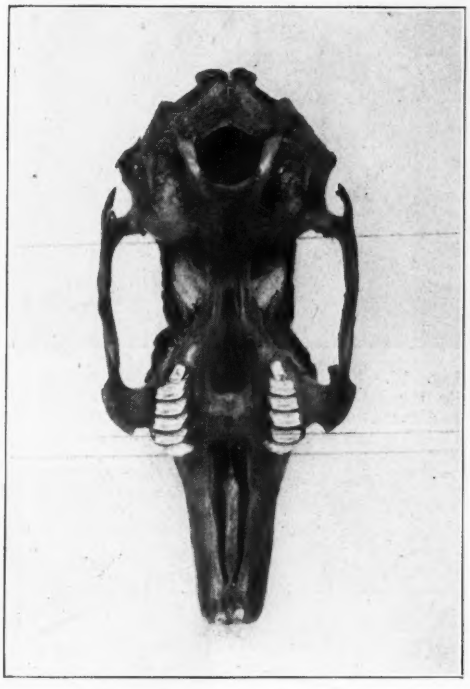


Fig. 11.—Lower aspect of Fig. 10.

side, as indicated by the shape and size of the condyle.† In the normal case *b*, it will be noted that there was an equilibrium of growth throughout, including both rami and condyles.

*Weight of animals:

Control	1631 gms.
1st operated on	1478 gms.
2nd operated on	1735 gms.

Weight of skulls:

Control animal	248 gms.
1st operated on	227 gms.
2nd operated on	243 gms.

†The fact that the condyles were varied by the interference with the functions of the teeth coincides with a theory advanced by Dr. M. H. Cryer, in his work on the "Internal Anatomy of the Face" (pp. 157-159—First edition) regarding the skull of a human being in which the individual was forced to put the mandible in an abnormal position in order to masticate. The change in the occlusal forces caused a difference in the shape and size of the condyles. Owing to the lack of occlusion on one side, the markings of the origins and insertions of the muscles on that side were much less well defined than on the working side. This same condition was evident in my experiment; in fact, the condition went so far that the zygomatic processes on the nonfunctioning sides were perceptibly atrophied.

Fig. 18 shows the posterior aspect of both skulls *a* and *c*, and reveals that the growth of those bones, far remote from the teeth, has been interfered with, as indicated by the lines passing through the junction of the superior aspect of the zygomatic processes and the sides of the brain-case, as well as by a

Fig. 12.—Lower jaw of operated-on rabbit. Note the lack of development of the condyle of the disused side.

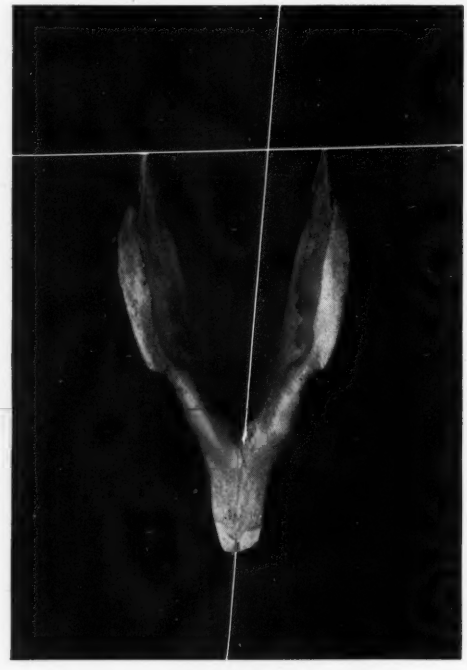


Fig. 13.—Lower aspect of Fig. 12.

Fig. 14.—Lower jaw of normal rabbit. Observe its perfect symmetry and contrast with Fig. 12.

noticeable variation in the zygomatic spaces themselves. These spaces on the side operated upon are visibly much smaller than on the functioning side, whereas, in the normal rabbit *b*, there is little or no difference between them. From all points of view, the overthrow of the balance of growth here indicated accords with that found in the other views of the skulls, as well as in the mandibles.

The results of this experiment seem remarkable to me. Who would have thought that, by interfering with the laws of occlusion, the skulls would have decreased in weight, and that every suture and every bone in the head would have varied as we have seen? This experiment strongly indicates how important is the masticatory equipment of man to the development of the head, and it also brings fresh illustration of the importance of the sadly

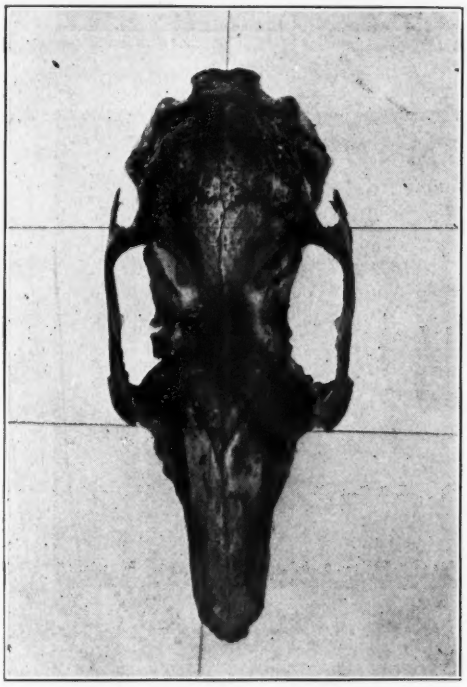


Fig. 15.—Upper aspect of the skull of another operated-on rabbit of the same litter. Compare with Fig. 8 and contrast with Fig. 10.

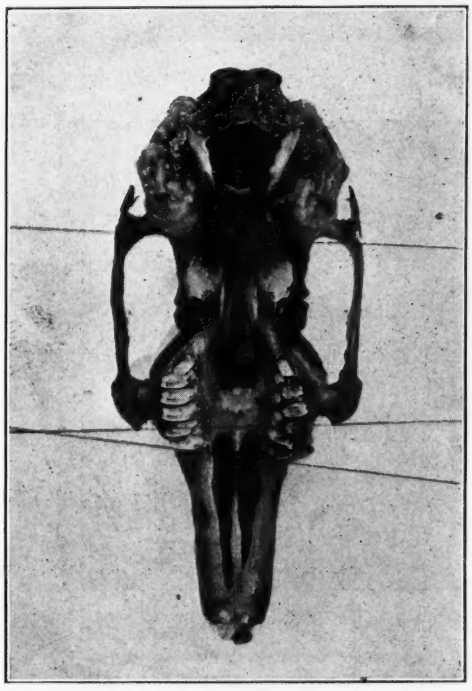


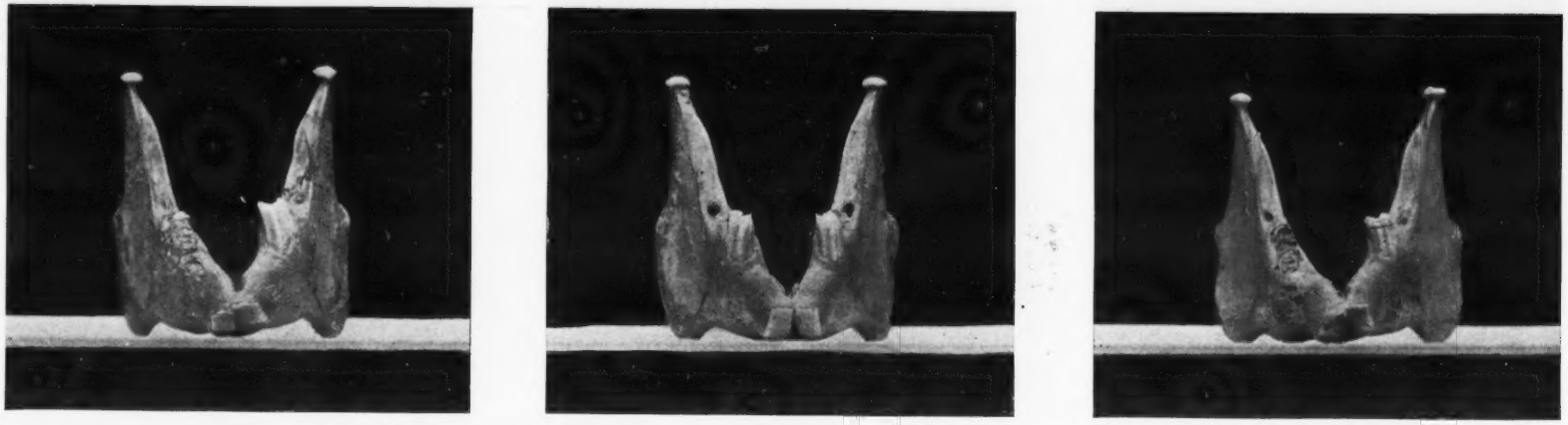
Fig. 16.—Lower aspect of Fig. 15. Compare with Fig. 9 and contrast with Fig. 11.

neglected deciduous dentition which serves during the important developmental period of childhood.

The statement that the shape of the skull in the lower animals can be modified, by simply interfering with the function of the teeth, seems almost incredible. The truth of this statement can be better understood when we study further into the great power of the masticatory muscular system.

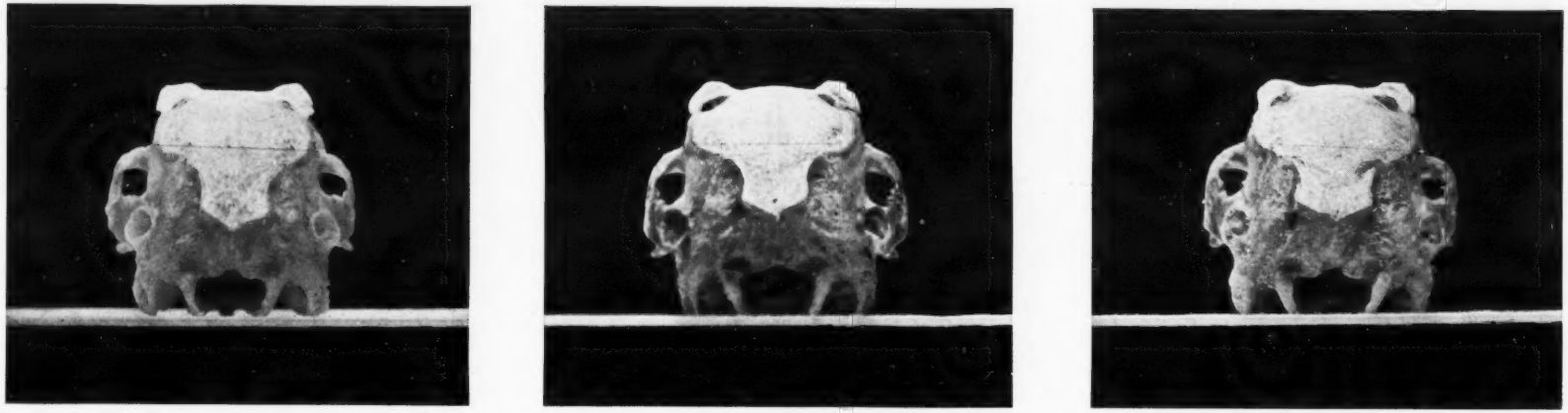
In the human being, the force required to thoroughly masticate a lean corned-beef sandwich, was estimated to amount to about three tons. Who would believe that 7,050 pounds of pressure were exerted on the bones of the skull through the medium of the teeth in masticating this simple article of food!

These figures were derived from the following test: A man with 32



A B C

Fig. 17.—Anterior views of mandibles. Observe similarity of variation of *a* and *c* and contrast with normal *b*.



A B C

Fig. 18.—Posterior aspect of skulls. Observe similarity of variation to Fig. 17.

teeth, in good condition, was selected for the test subject. The test food consisted of an ordinary lean corned-beef sandwich, (2½ inches by 3½ inches). This was masticated until it was involuntarily swallowed. The number of mouthfuls, and the number of chews per mouthful, and the time consumed, were all carefully noted, the force with which the teeth were brought together was estimated to be 10 pounds for each contraction of the muscles of mastication, which is a very conservative estimate.* The time consumed in leisurely eating the test food was about nine minutes, and, as has been stated, the estimated force was 7,050 pounds. A second person in making a similar test, required 52 contractions less than the former, but the meat was much more tender than in the first case.

If these deductions are at all accurate, the force exerted on the skull through the medium of the teeth over a period of time can be easily calculated, and will be found to be enormous. Thus we readily see how interfering with one side of the dental equipment in an animal can affect the shape and structure of the skull, for, according to the laws of evolution, we know that the continuous muscular force exerted on a given bone determines the shape of that bone.

I now wish to report on my experiments with another type of herbivorous animal, the sheep. For this experiment, two animals of the same birth were selected for the test, and for the control, I procured their mother. In the first animal I eliminated, as best I could, the function of the left lateral half of the dental apparatus, by cutting off both the maxillary and mandibular teeth on that side. In the second animal, the function of the right lateral half was interfered with by cutting off only the mandibular teeth on that side.† After seven months, the skulls were procured and the next series of illustrations shows the state of growth.

Fig. 19 is from a photograph of the lower aspect of the skull of animal No. 1. The drawn line extending along the sutures of the palate passes markedly to the left of the center of the foramen magnum. This shows an asymmetric growth of the skull which corresponds in a striking manner to that observed in the rabbit experiment, but, of course, here it is towards the

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*The amount of force required to crush food has been very carefully studied by two investigators: Dr. G. V. Black and Dr. Joseph Head. Dr. Black confines his work to the *direct* force required to crush food (see Dental Cosmos, 1895 xxxvii, 478-484) while Dr. Head directed his investigation towards the *trituration* of food (see Dental Cosmos, 1906, xlviii, 1189-1192). Both of these experiments were more to determine the crushing point of food than the amount of force required to masticate food; so, to estimate the force required to masticate a given article of food, the number of closures of the jaws must be considered.

The following table shows the comparative results of these two investigations in crushing meat. It will be noted that the trituration gives a lower crushing force, with one exception, than the direct pressure:

	Dr. Head lbs.	Dr. Black lbs.
Corned beef	18-22	30-35
Tenderloin of beefsteak, very tender	8- 9	35-40
Round of beefsteak, tough	38-42	60-80
Roast beef	20-35	35-50
Boiled Ham	10-14	40-60
Pork Chops	25-30	20-25
Roast Veal	16	35-40

†Owing to the fact that after the operation, the animals did not thrive in confinement, they were sent to the country for board, where it was impossible to have them under as close observation as they should have been, and, unfortunately, during this time, the posterior molars erupted and were functionating, so that the outcome of the experiment was interfered with. Nevertheless, the results are worthy of note.

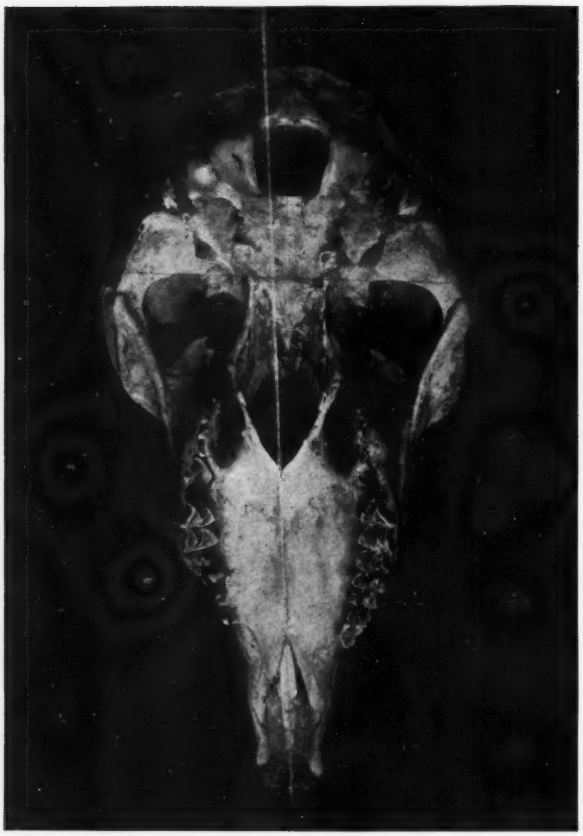

Fig. 19.—Lateral asymmetric development of skull of sheep due to interference with the occlusal forces of the left lateral half of dental apparatus.

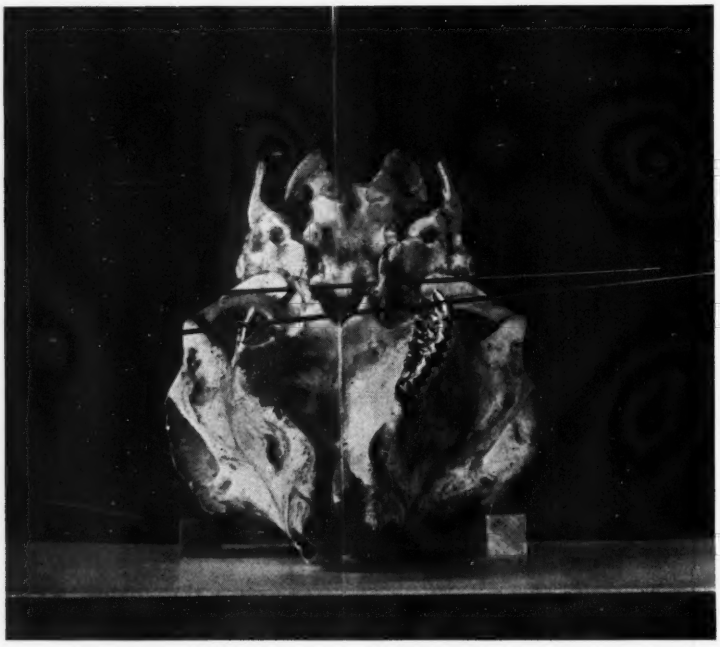

Fig. 20.—Vertical asymmetric development of same.

opposite side, for in this instance the left lateral half of the dental apparatus is interfered with, while with the rabbits the right lateral half was operated on.

Not only was the growth of the skull distorted in the lateral plane, but, as shown in Fig. 20 there was also a vertical distortion as well. (The vertical measurements were made with long steel wire pins, one resting on corresponding depressions of the articular surfaces of the glenoid fossæ, the other pin

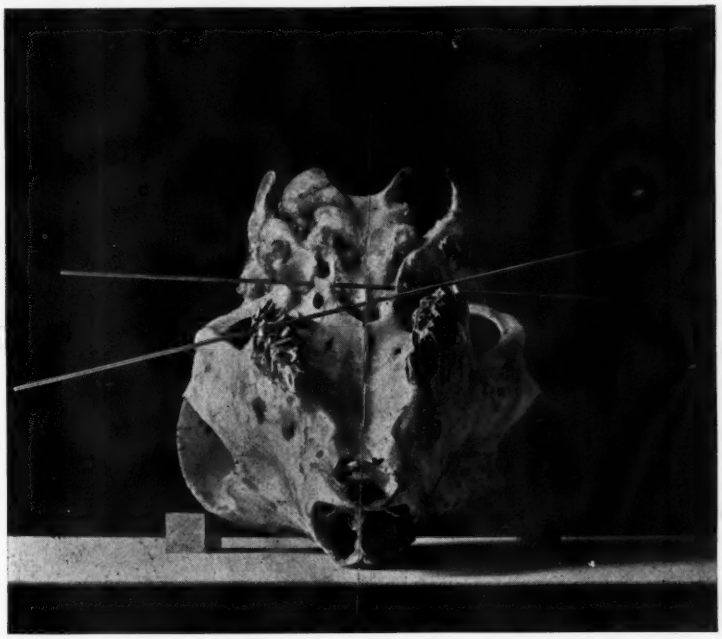

Fig. 21.—Vertical asymmetric development of sheep No. 2, due to interference of only the lower right teeth. (Contrast with Fig. 20.)

Fig. 22.—Section of skull No. 2.

resting on the corresponding depressions of the corresponding molars. The latter points, I consider as accurate as could be obtained, for, as stated in the footnote, page 273, the posterior molars erupted during the experiment and their function was not interfered with.)

Fig. 21 is of the skull of animal No. 2 and corresponds with Fig. 20 of animal No. 1. It will be remembered that in this case the interference was

confined to the mandibular teeth of the right side and that the maxillary teeth were not interfered with during the experiment. Here it is observed that the nonfunctionating teeth, with their alveolar process, have elongated to a marked degree, and that the skull in the region of the temporomandibular articulation is twisted in the opposite direction, as indicated by the steel wire resting in the glenoid fossæ. This vertical twist of this part of the skull corresponds well with that in animal No. 1, but, of course, in the opposite direction, because of the interference with the opposite side.

There is in this experiment one fact which I cannot account for, and that is, in animal No. 2 there is very little lateral twisting of the anterior part of the skull, while in animal No. 1, it is quite marked. I now realize that it would have been better had I interfered with both animals in the same way, as I did in my rabbit experiment.

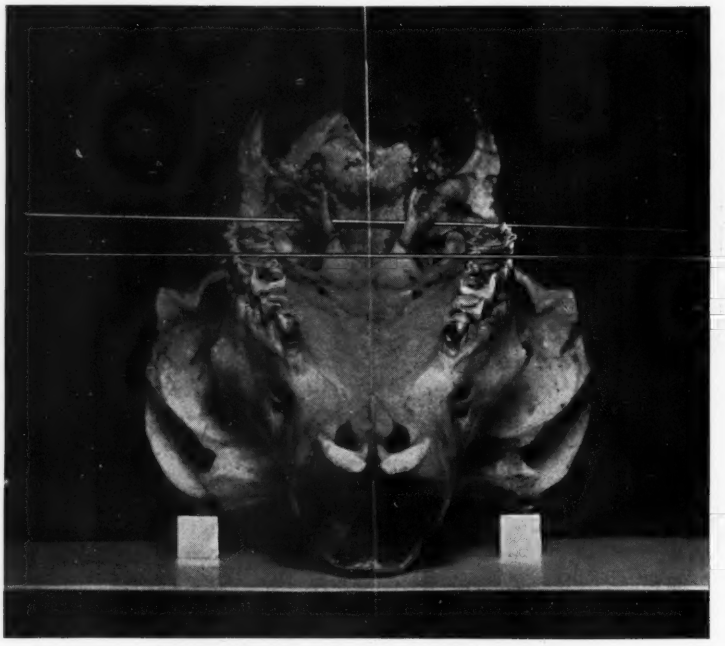

Fig. 23.—Normal growth of control sheep.

Fig. 22 is a section through the 3rd molar region of animal No. 2. Here again, the vertical distortion is plainly visible. This view, furthermore, shows that there has been an arrest in the development of the palate in both breadth and thickness of the right, or nonfunctionating side. This lack of growth is not confined to the palate alone, for the breadth of the entire right lateral half is less than that of the left, or working side. The observer can test this himself by measuring from the nasal septum to the external surface of the bones.

Fig. 23 is of the control and shows normal development.

I now present for your consideration a partial report of an experiment on a dog.* I greatly regret that this report is not complete; the incomplete-

*Dr. Richard Landsberger of Berlin, Germany, in investigating the influence of the eruption of the teeth in the development of the maxillary bones and nasal cavities, removed from very young dogs one lateral half of the dental apparatus and found that not only was the growth of the maxillary bones and nasal cavities affected, but much to his surprise, found that the removal of the teeth had brought

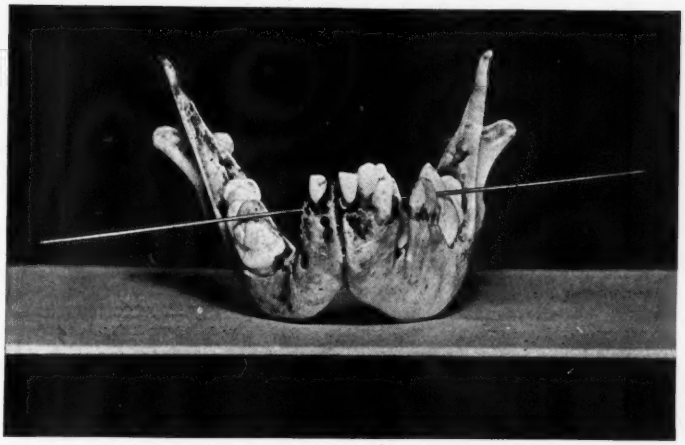

Fig. 24.—Anterior view of mandible of dog, showing lack of development due to interference with occlusal forces of the right lower teeth.

Fig. 25.—Posterior view of Fig. 24.

Fig. 26.—Observe the asymmetric development in the mandible of the cat, due to the removal of the mandibular teeth on left side.

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about an asymmetric development of the entire skull. See "Der Einfluss der Zähne auf die Entwicklung des Schädels" von Dr. Richard Landsberger, Berlin; ein Vortrag gehalten auf der Versammlung der Physiologischen in Berlin, December 11, 1911. Arch. f. Anat. u. Physiol., 1912. Compare with my "Preliminary Study of the Influence of the Forces of Occlusion on the Development of the Bones of the Skull". Read before the American Society of Orthodontists at Denver, Colo., July 13, 1910, and published in the *Items of Interest*, February, 1911, xxxiii, No. 2.

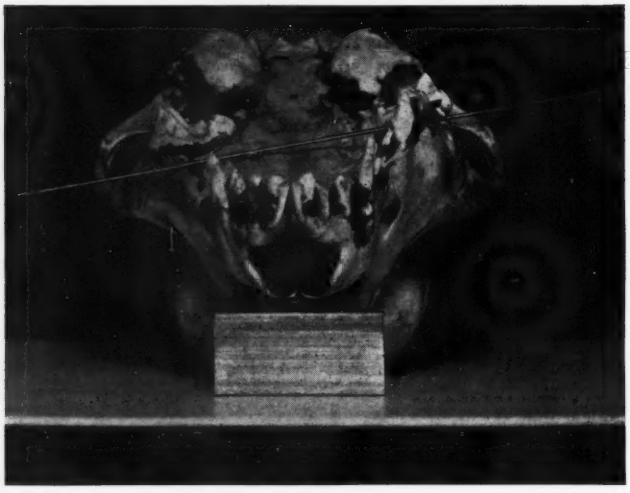

Fig. 27.—Skull of same dog. Observe the vertical distortion.

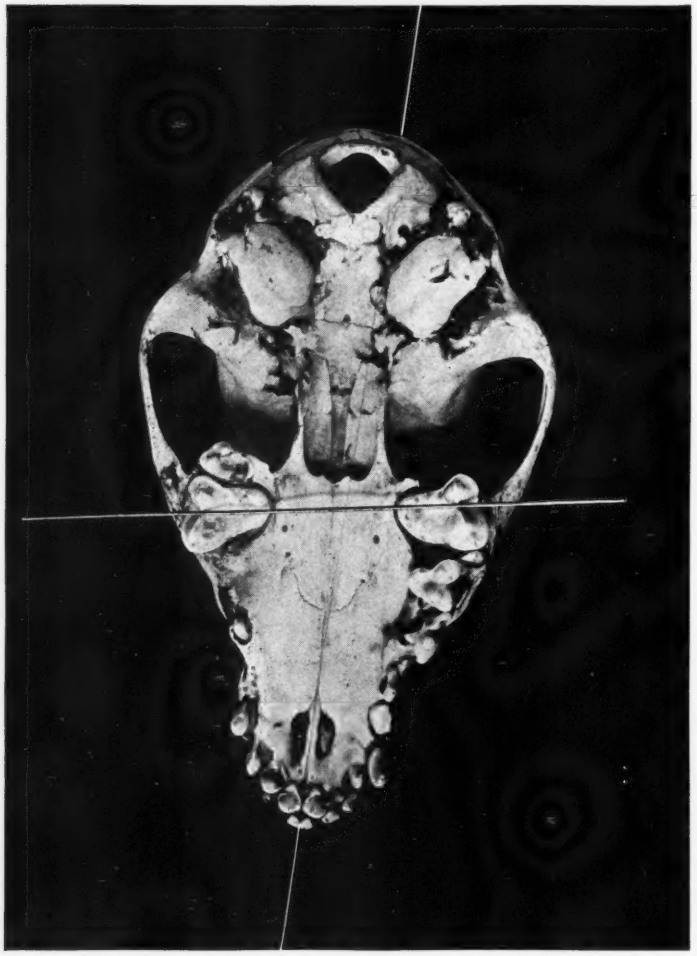

Fig. 28.—Same lower aspect. Observe the lateral twist of anterior part of skull.

ness is owing to the fact that, in spite of the best of care, the entire litter, including the control, died before the prescribed termination of the experiment.

In this particular animal, I interfered with the function of the mandibular teeth on the right side. After four months and fourteen days from the date of the operation, the skull was obtained and the following illustration shows the state of growth. Figs. 24 and 25 are of the mandible. It will be observed that among other changes in the body of the bone, the condyle of the non-

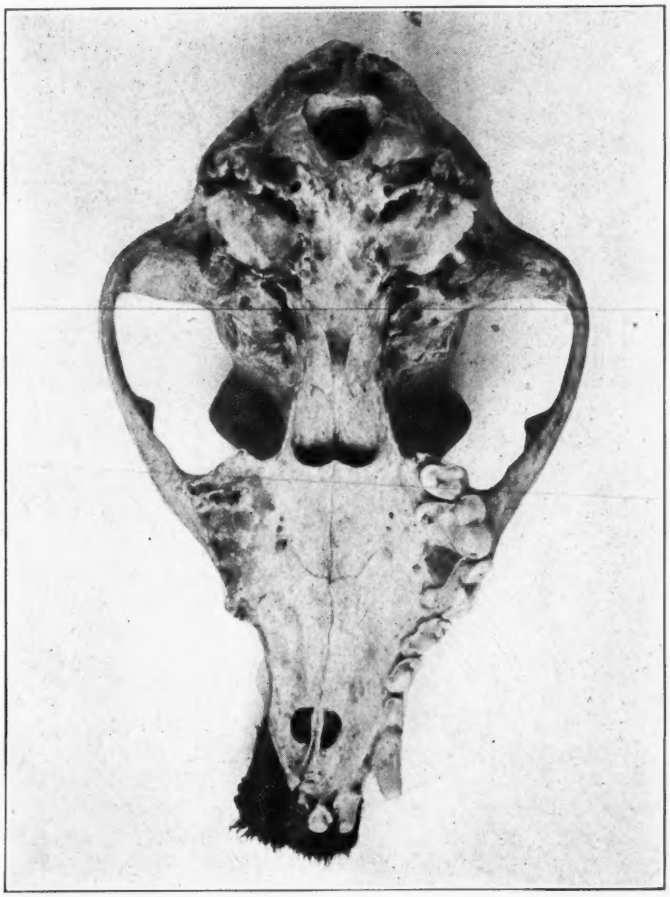

Fig. 29.—Observe the asymmetric development of the bones of the skull of a dog due to the interference with the function of the upper left lateral half of the dental apparatus.

working side is less well developed than that of the noninterfered-with side. (Compare with Fig. 17 rabbit experiment.)

To me it seems remarkable that there should be such a bone change in so short a time, especially as, during this period, the posterior molars erupted and were functionating. (The condition of the animal prevented etherization and no second interference was attempted.)

Fig. 26 is here introduced to show the effects of the *complete* unilateral elimination of the dental apparatus in the mandible of the cat. This specimen does not strictly belong to this series, but it so beautifully shows the result of functional interference that it is worthy of consideration.

Fig. 27 is an anterior view of the dog's skull, and here a vertical distortion is manifest. Fig. 28 is of the lower aspect. The line drawn along the intermaxillary suture passes to the right of the foramen magnum, showing that the anterior part of the skull had already begun to deviate.

The knowledge acquired during this preliminary experiment on the dog stood me in good stead in the next dog experiment, the results of which are shown in Figs. 29, 30 and 31.

It will be observed in Fig. 29, which is of the lower aspect of the skull,

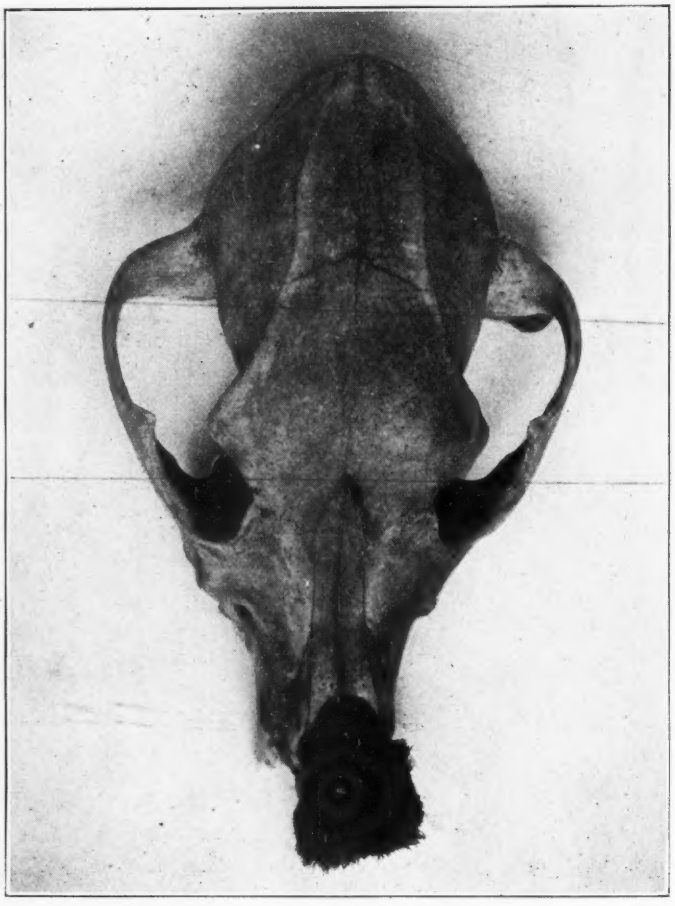

Fig. 30.—Upper aspect of Fig. 29.

that in this animal I quite successfully eliminated the function of the teeth of the left (right side in the photograph) lateral half of the maxillae. The effect of this consequent unilateral function of the forces of occlusion is clearly demonstrated by the deformed skull. (The mandibular teeth were not experimented with.)

Fig. 30 shows the upper aspect of the same and it will be noted that the deformity extends throughout the entire skull. In fact the deformity was so excessive that during the experiment, the animal man, a most conscientious individual, came to me in a distressed state of mind saying, "that something was wrong with the head of one of my animals, for it was becoming badly

twisted, and that one of its eyes was growing out of place." It was needless to say that this information pleased me, for it showed that my interference with the occlusal forces was bringing about tangible results.

The effect of this unilateral interference with the maxillary teeth had an interesting effect on the mandibular jaw (which, as before stated was not interfered with) for aside from the results observed in all the other mandibles of the operated-on animals there was excessive atrophy, or lack of development

A

B

Fig. 31.—Mandible of skull shown in Figs. 29 and 30. Compare the development of the alveolar process in *A* and *B*. The atrophy of the process in *B* is worthy of note and is due to lack of use, the upper left lateral half of the dental apparatus being removed.

of the sockets of the teeth on the nonfunctioning side so that these nonfunctioning teeth were beginning to show signs of loosening. This condition is illustrated in Fig. 31*b*.

There is still another group of animals that should be included in these researches, and it is the primate group. As a matter of fact, I have already attempted to work on these animals, but have never been able to get results, for they are so delicate that they did not long survive in our changeable New England climate. It has been one of my cherished hopes to make a trip to

the tropics and carry on my researches with these animals; but I see no prospects of making this extended journey, so I would therefore be grateful if any reader from these regions would carry on these interesting experiments for me. I would be glad to send them the necessary instruments and help them in any other way that is in my power.

In conclusion, I wish to state that, although I have been working at this problem for a number of years, it has progressed very slowly, due largely to the fact that each experiment extends over so long a period of time, and also because it is a very difficult matter to completely eliminate the functions from one lateral half of the dental apparatus. The persistency with which Nature adapts the occlusion of the interfered-with teeth for use is remarkable, and strongly points out the importance of the dental apparatus in the scheme of life.

I fully realize that a hostile observer could criticize this work, as far as I have carried it, as being incomplete; but those who are familiar with the biology of bone growth, and who appreciate that muscular action, blood supply, and cellular activity are all bound together in bone development, will, I think, appreciate the significance of this line of investigation, and will perceive its importance in the development of the bones of the head and the organs incased therein.

The fact that my investigations are, perhaps, another reason for making the general practitioner appreciate the far-reaching influence of preserving the deciduous dentition which serves during the important developmental period of childhood; and also that orthodontists are referring to it as a plea for the establishment of the occlusal equilibrium early in life, stimulates me to carry still further this slow and patient work.

DISCUSSION

Dr. Milo Hellman, New York City.—I would like to ask Dr. Baker a question. I should like to know how the teeth were mutilated in the last dog.

Dr. Baker.—The function was interfered with by extraction. In the other group of animals, namely the rabbit and sheep, I found by working on dead animals, that the teeth were so firmly rooted, it was impossible to extract them without causing serious damage, so I had to resort to frequent incising of the teeth.

Let me add, the animals received most excellent care. The various operations were performed under an anesthetic, and the care-taker saw to it that they received the best of food and shelter—in fact as Dr. Cannon said—"nowadays we treat our experimental animals better than our patients."

Dr. A. LeRoy Johnson, Boston, Mass.—Dr. Baker has given another demonstration of the law formulated in 1884 and 1885 by Julius Wolff, known as Wolff's Law. It reads:

"Every change in the form and the function of a bone or of their function alone, is followed by certain definite changes in their internal architecture, and equally definite secondary alternations in their external conformation, in accordance with mathematical laws."

The impression one gets from Dr. Baker's demonstration is, I think, misleading. We cannot believe, and no evidence has been presented to substantiate the belief, that the form of the human head, more especially the brain case, is solely determined by the pull of the

muscles of mastication. Phylogenetically there is a correlation between the size and form of the brain case and the muscles of mastication, particularly the temporal, but a correlation does not necessarily designate a cause. Moreover, except under pathologic conditions osseous tissue will not impinge upon nervous structures, the latter are physiologically dominant. Thus, while we recognize the action of the muscles of mastication as factors in the development of the head, it is not reasonable to give them too much emphasis. In fact, the validity of the universal application of Wolff's Law is at present being questioned. I refer to the work of Mark Jensen on "Bone Formation."

Dr. Victor Hugo Jackson, New York City.—With reference to the experiments made in shutting off the air from one nasal opening, Zeim, of Germany, in his experiments on growing animals, to determine the cause and effect of nasal stenosis, obstructed one nasal orifice, thus withdrawing the normal nutrition from that one contrasting it with its fellow.

As a result, which illustrates the effect of stenosis on the development of the bones, there was observed a deviation of the intermaxillary bone and the sagittal suture towards the occluded side, a shortening of the nasal bone, frontal bone, horizontal plate of the palate bone, flattening of the alveolar process, and a reduction of the distance between the auditory canal and the alveolar process, as well as between the zygomatic arch and the supraorbital-border. (Jackson Orthodontia, Page 30.)

Dr. Lawrence W. Baker, Boston, (closing).—I quite agree with Dr. Jackson in that shutting off the air from one nostril will bring about an asymmetric development of the bones of the skull. Dr. Willis S. Anderson, in our country performed a similar experiment and brought about, not only a marked bony change in the skull, but also his experiments caused, through lack of proper oxidization of the blood, many far-reaching effects on the growth of the animals. I strongly advise all to read the report of this classic experiment which was read before the American Laryngological, Rhinological and Otological Society at Atlantic City, June, 1909.

I am glad Dr. Johnson has emphasized the fact that there are other forces which contribute to the development of the skull other than muscular force. No doubt I have laid so much stress on muscular force, it may be I have unconsciously misled you. However, in my introductory remarks I stated there are two great groups of forces at work which combine to determine skull form—one group operating from within, while the other group operates from without. However, I think all will agree with me in that muscular force is a most important factor in the latter group, and that the bony changes were brought about primarily by my interfering with the occlusal forces, which after all are in reality nothing more or less than the reaction of the forces of the muscles of mastication.

Dr. J. Lowe Young, New York City.—Take one of these puppy dogs and feed him on milk. As long as you keep him alive he does not chew anything, and see what you get. Do not touch his teeth.

Dr. Baker.—What do you think you will get?

Dr. Young.—I don't know anything about it. (Laughter.) I want you to find out.

A COMPLETE CLINIC ON ORTHODONTIC ENGINEERING*

By Lionel Hartley, D.D.S., New York City

THE advantages of surveying the models of orthodontic cases are many, the principal *one* being the elimination of 95 per cent of the guess work, in which we are compelled to indulge.

By using some method of surveying combined with engineering, we are enabled to get an accurate drawing of both the maxillary and mandibular teeth, separate and in combination, showing the existing quantity of tooth substance in both jaws in occlusion, or in as near occlusion as it is possible to put any particular set of teeth. (This gives us a positive knowledge before we start our work, instead of a long time after.)

We are enabled with mathematical accuracy to ascertain the *minimum* amount of tooth movement necessary to put the entire denture into occlusion and by superimposing the drawing of the teeth in malocclusion, on that of the drawing of the teeth in occlusion, we know at a glance the amount of movement necessary for each individual tooth and can design appliances which will effectively do the maximum amount of work, with the least amount of discomfort to the patient.

We have an accurate check on the progress of our cases and can see whether our appliances are doing the work imposed upon them, by making progress surveys at stated intervals.

In so-called "open bite" cases, accurate *vertical* surveys can be made and by drawing the line of the compensating curve and the line of occlusion we can accurately show on paper, the amount of supra- or infra-version (as the case may be), of each individual tooth.

The apparatus I use consists of a leveling table for the models and a combined surveyor and pantograph, which simultaneously surveys, projects and enlarges the drawing five diameters. (The object of enlarging five diameters instead of exact size or ten times, is because in the former size the drawings are too small for correct calculations and in the latter size, the enlargement is too great to be within the angle of vision of normally sighted individuals.)

The surveyed points of projection are then joined by hand with pen and ink on tracing paper.

The landmarks that are surveyed are the gingival circumferences, the grooves and sulci, the cusps and ridges of each tooth and the rugae.

The mesiodistal diameters are measured on these surveys and marked on two wires, (representing maxillary and mandibular jaws).

The surveys of the maxillary and mandibular first molars are fitted into occlusion and the amount of overhang and overlap measured. These points become points of fixation in joining the wires with the mesiodistal diameters marked on them. It then becomes possible to design an arch within anatomical limits, with a reasonable overbite, provided the tooth substance in the maxillary and mandibular jaws match.

*Read before the American Society of Orthodontists, Atlantic City, N. J., April 27, 1921.

THE PROBLEMS OF MODERN ORTHODONTIA*

By Dr. James T. Quintero of Lyons, France

(Translated by Margaret Gortikor, D.D.S., New York)

I WANT to tell you how greatly I realize the responsibility you have placed upon me. The tasks which confront us are numerous and various. Should I not choose and invite the best scholars and orators capable of teaching us to prepare something for our annual meeting thereby guiding us in our discussions to produce truth, eliminate the false, and emphasize the facts that are the most important with useless details placed in the background? All this requires authority and prestige, qualities which others might possess better than I. Still all this may not be possible if one limits himself to a definite line of conduct. Let us try to find out today what our young Society can do toward advancing our specialty. Orthodontia has a definite purpose and certain needs.

The needs of modern dentofacial orthopedia are numerous. It is nearly two hundred years since our forerunners Fauchard and Bourdet accomplished their aims. It is no longer merely a question of how nicely we can bring the teeth into alignment, but we must determine the condition of each maxillae, their relationship to each other, to the face, to the alveolar borders and to the teeth. We must examine the alveolar process and the teeth in regard to their relationship to the surrounding parts. Then we must decide in what respect each part is abnormal and consider the methods of treatment and try and choose the best. What are the fundamentals of our work? We do not exactly know what a normal maxilla, a normal denture or a normal occlusion is. Notwithstanding this, do not these very points form the basis of our specialty? How can we claim to perfectly correct dentofacial malformations when we do not possess an accurate knowledge of the normal conditions we should produce? I want to recall to your mind the work of Bonwill and of Hawley, who originated certain ideas, remarkable though their work be, still it is far from perfection and even though they may have constituted a very important step of that epoch, today their ideas are insufficient. The same criticism can be made of more recent work. In France we have scholars, men such as Crois, Siffae and Pont. Each one has contributed a part toward the construction of this edifice but still we have not attained our end. Here, now, is the first object toward which we can direct our combined activities.

Let us look into the future. Having determined what is normal in a particular case and the relationship of the regions we are interested in, we should know how the case deviates from the normal. We must have a language and terminology which will describe the malocclusion. Even now, France has contributed much toward the advancement of our specialty. I need only mention the works of Frey, Lemiere, Bogo de Nevrize and Villian, as

*Read before the Société Francaise d'Orthopédie Dento-Faciale, Lyons, France, session of May 22, 1921.

they are well known to you all. Can it be that we are not progressing? It is hardly probable because the uncertainty of new discoveries is proportional to the progress of our science. We have here a second field of investigation before us.

Let us advance another step. Having studied the various irregularities of the case, we must eliminate from our minds the minor details and consider only the principles that enable us to make a diagnosis, that is to classify the case as it deviates from the normal. Shall we follow the classifications brought over from America, as Angle's, later modified by Lischer, a modification which deals with terminology that does not change the fundamentals? The latter classification of Calvin S. Case, likewise based on that of Angle is no more satisfactory to the scientific spirit of the French. We therefore, find ourselves confronted by a third problem that must be solved.

We can still go farther and ask what type of appliance should we adopt? Ought we, like the Americans, endeavor to make the appliances small and delicate with a slow, continuous action; more physiologic, if the term may be thus employed, less annoying because of their form and position; or on the other hand, should we imitate the Germans who tend to make their patients wear heavy, bulky appliances which have a rapid action but produce more pain? Should we give preference to a fixed appliance or removable appliance? What should we decide upon in reference to retaining appliances? We have a great many questions of the most pressing nature for those who always want to work a little better. There are many points of doubt which demand prompt and definite answers in order to permit each one to solve his own problems with the least amount of hesitancy and uncertainty.

I have mentioned only the practical points that are the most urgent. There are other problems such as instrumentation, tools, material and operative technic, other questions solicit the attention of those who are attracted by the work for the sake of science.

Among the latter questions can be mentioned the tissue changes during orthodontic treatment, the influence of the endocrin glands and the disturbed functions of the same as well as the part played by heredity in different forms of malocclusion. We have the problem of the stress sustained by the various parts of the appliances, the proper size for each to resist the forces and to transmit same to the malposed teeth including the question of the best alloys found in the construction of the appliance.

Many of these investigations require well equipped laboratories, which few of us have at our disposal.

Are any of the problems I have just enumerated completely solved? We should admit our ignorance in regard to all of these big problems of dento-facial orthopedia as well as problems of biology in general. Who will give us the key to all of these mysteries? I believe the solution is still far off, but it behooves each of us to do all within his power to help overcome these difficulties by bringing to this Society the facts known and always seeking to improve yourself and thereby be able to render better service to your patient.

Gentlemen: I now open the first meeting of the "French Society of Dento-Facial Orthopedia."

PRESENTATION OF MODELS AND APPLIANCES

One Case of Fracture of Maxillary Central Incisor Corrected by Regulating*

By Dr. M. H. J. Harwood, Lyons, France

(Translated by Margaret Gortikor, D.D.S., New York)

Miss M., age sixteen years, while playing, broke off the incisal edge of her maxillary central incisor, presented herself at my office. There were two solutions, devitalize the tooth and replace it with a pivot tooth aligned with the approximating teeth or (as I had already done in a similar case) add an enamel tip supported by two pins which penetrated the dentin but still not interfering with the vitality of the pulp.

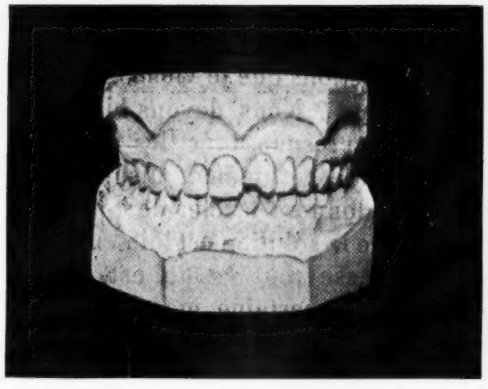

Fig. 1.

Fig. 2.

Because of her age, the parents objected to the use of a pivot tooth. The enamel tip might change color, due to long use, lose its gloss as frequently happens with plastic enamel. Therefore, another method was devised.

In the treatment of malocclusion, we are obliged to move teeth in an occlusal or gingival direction. I thought that by applying those two movements I might be able to compensate for the difference in length between the fractured tooth and the approximating tooth.

It will be noticed (Fig. 1) that the fractured tooth overlaps the approximating central, which caused us to begin by correcting the direction of its long axis. This was brought about by the appliance shown in Figure 2.

A band with a gold wire, soldered vertically to it, was cemented on the tooth, each end of the wire being bent into a hook. The bands with tubes were cemented to the first molars which served to support a labial wire. To the

*Read at the meeting of the Société Francaise d'Orthopédie Dento-Faciale, Lyons, France, May 22, 1921.

labial wire are soldered the hooks, which are connected to the gold wire hooks soldered to the incisal band by means of rubber ligatures. This device produces a reciprocal movement thus changing the direction of the vertical axis of the tooth.

The rotation is then obtained by the standard use of the double ligature and in this way the tooth falls into the line of occlusion. The labial wire was then replaced by another wire resting at the gingival margin of the teeth. The anterior part of the labial wire supports a second wire which is near the incisal edges. (Fig. 3.)

Fig. 3.

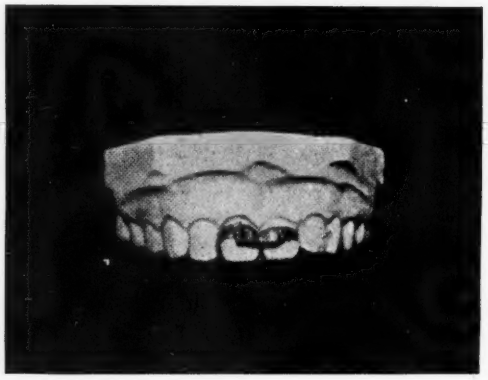

Fig. 4.

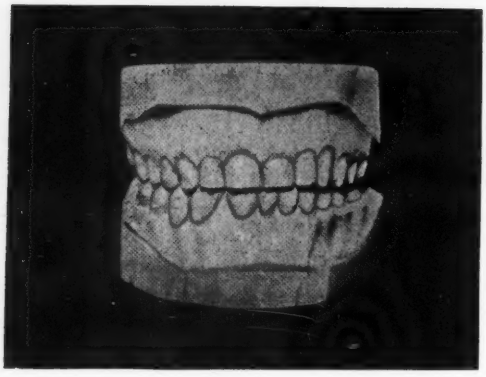

Fig. 5.

To the neck of the fractured tooth (left central incisor) a wire ligature is attached and the free ends of the ligature are twisted around the lower wire. By twisting the wire, the tooth is drawn down by degrees. At the same time another wire ligature which surrounds the middle third of the right incisal crown, has its free ends twisted around the upper wire. Gradually this tooth is drawn up until finally both teeth are the same length.

In moving the fractured tooth, the line of fracture which was oblique at first, became almost horizontal. It required very little grinding to straighten the edge.

The next question was to retain the teeth in position. I preferred to let each tooth be as independent of the other as possible. Instead of holding the

teeth by the use of two bands soldered together, the band for each tooth is absolutely separate. The band on the right incisor has a small ring into which fits a small stem which is soldered to the band on the left incisor. The appliance exerts a little spring so that any tendency on the part of the teeth to return to their former position, is opposed. (Fig. 4.)

This retaining appliance was left in position for a year without any change being produced.

The last model (Fig. 5) was made one year after the removal of the retaining appliance; according to recent information—for the patient has left Lyons—no change has taken place. A slight difference will be noticed at the gingival border of the tooth which was drawn down.

TRANSPALATINE ARCH*

By Dr. James T. Quintero, Lyons, France

(Translated by Margaret Gortikor, D.D.S., New York)

THE appliance that I am showing is distinctly derived from Mershon's lingual arch. It sometimes happens, when we are confronted with certain types of malocclusion in which there is a close bite, that a lingual wire can-

Fig. 1.—Transpalatine arch with auxiliary springs.

not be made to occupy the correct position as it will interfere with the occlusion of the mandibular anterior teeth.

All these cases are very troublesome to me, because I have abandoned the use of all appliances, except Mershon's arch, a long time ago, and so I am obliged to look elsewhere for a solution and the results of this searching I am showing you today.

In almost all the cases we have to treat, the malocclusion consists of one principal trouble, namely, maldevelopment of the maxillae. We must combat this condition first, before we can hope to obtain a definite result from ortho-

*Presented before the Société Francaise d'Orthopédie Dento-Faciale, Lyons, France, May 22, 1921.

dontic treatment. It little matters whether we correct the torsiversions and linguoversions unless the dental arch is the proper size. It is not until the size of the arch has been remedied that we can consider secondary corrections; that is, the various malpositions which a small number of teeth assume. In order to obtain expansion, what must be done? A slow and gradual pressure must be exerted upon the lingual surface of the teeth. We obtain this pressure by constructing an appliance anchored on the molars and having a socket with a lock. The appliance, instead of being weak because of the long irregular curve it makes in passing around the entire dental arch, acquires strength by the passing directly across the palate from the anchor tooth on one side to the one on the opposite side, thus making a short appliance. If you wish to obtain expansion, not only of the anchor teeth but also of the other teeth on either side, two methods are available, we can use spurs soldered directly to the bands or we can use, as in the model of the cut, auxiliary springs passing from the anchorage socket and directed horizontally forward to the last tooth we wish to expand.

This method permits of an expansion indiscriminately whether it be of the anterior teeth or of the posterior, all depending upon the type of irregularity with which we have to deal. This is done simply by modifying the strength and action of the springs on the main appliance.

TREATMENT OF A CASE OF A MALERUPTED CANINE BY A LINGUAL APPLIANCE*

By Dr. B. de Nevrèzé, Paris, France

(Translated by Margaret Gortikor, D.D.S., New York)

THE case which I will present to you is characterized by two malpositions:
(1) In a transversal or frontal sense by a maldeveloped maxillae.

(2) In an anteroposterior or sagittal sense by linguoversion of the two maxillary right centrals.

This double lesion has caused the space necessary for the maxillary right canine to partially close up and cause the canine to erupt in infralabioversion. (Figs. 1, 2 and 3.)

The only difficulty in treating this case was that the patient objected to any visible appliance, despite the fact that she was only 15 years of age and so had no social obligations of importance.

The lingual appliance was particularly indicated and the cuts show that I employed it in two forms in an absolutely individual manner.

The first form of lingual appliance (A) was constructed with two auxil-

*Read before the Société Francaise d'Orthopédie Dento Faciale, Lyons, France, May 22, 1921.

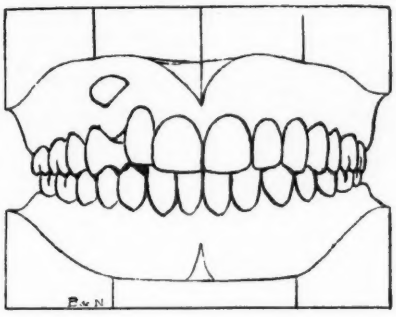

Fig. 1.—Front view of model before treatment.

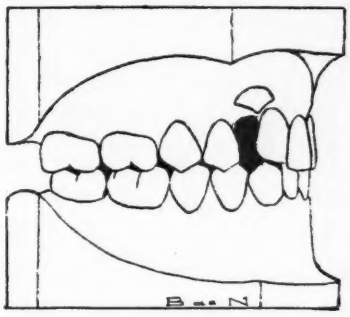

Fig. 2.—Side view of model before treatment.

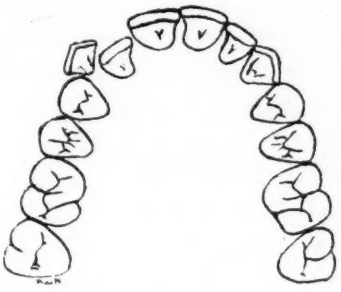

Fig. 3.—Occlusal view of model before treatment.

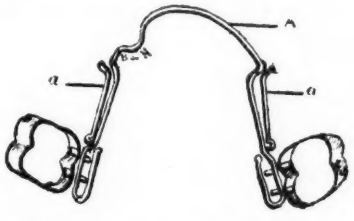

Fig. 4.—First form of appliance. *A*, Lingual Appliance, *a*, *a'*, Auxiliary springs.

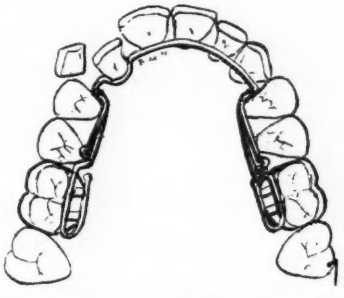

Fig. 5.—First form of appliance in position.

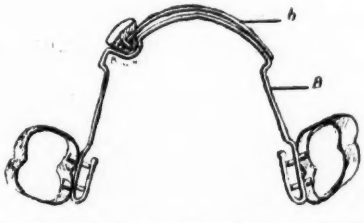

Fig. 6.—Second form of appliance. *B*, Lingual appliance, *b*, Auxiliary spring.

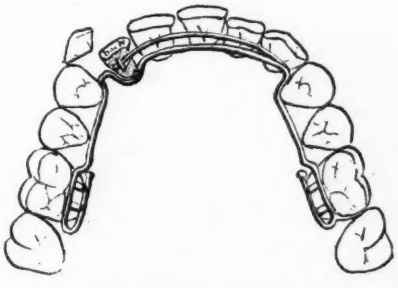

Fig. 7.—Second form of arch in position.

iary springs (a and a′) which rested on the necks of the premolars. These springs widened the premolar region to the extent determined by Ponts indicator.

Second form of lingual appliance. (Figs. 6-7.) A second lingual appliance (B) replaced the first and had but one auxiliary spring (b) which pushed forward the two maxillary right incisors.

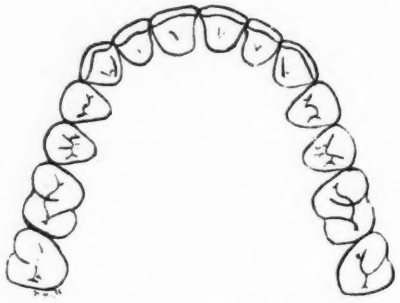

Fig. 8.—Occlusal view of model after treatment.

The space necessary for the eruption of the maxillary right canine in its proper position was obtained in 6 months. (See Fig. 8.)

(a) Without a visible appliance.

(b) Without any pain.

(c) Without loss of time (12 to 15 visits).

AUTOGENOUS SOLDERING OF BANDS IN DENTOFACIAL ORTHOPEDIA*

By Dr. James T. Quintero, Lyons, France

(Translated by Margaret Gortikor, D.D.S., New York City)

IT is nearly ten years since I began experimenting with bands in view of eliminating all of the inconvenience of soldering that occurs. These inconveniences are of several types, first as regards strength, the bands always are weak at the point of soldering. Now as for soldering such as is practiced in orthodontia: a lump is formed greater than the thickness of the band and though very slight in nature, still it proves an obstacle to the patient when cleansing it and it is also a choice place for the accumulation of food and debris after mastication.

If you should attempt to grind or polish away the projection you will weaken the band greatly. Finally, the presence of this projection is unsightly and if it is large in size, it may prove to be a source of irritation to the soft tissues with which it comes in contact.

Thus by a series of experiments I have endeavored to determine the best

*Presented before the French Society of Dento-Facial Orthopedia, Lyons, France, May 22, 1921.

methods for preventing these inconveniences. I am convinced that it is advantageous to abandon the use of common metals and the alloys ordinarily employed and use only precious metals in their stead. But the iridio-platinum which I employed so readily before the war, today is prohibitive in price and as for the alloys which formerly gave me the best results, they come from Germany. In addition, the autogenous soldering of platinum requires an oxyhydrogen blowpipe and besides the result might be doubtful. Thus I have decided to use naught else but 22 K commercial gold. It is easy to manipulate, solders easily, is malleable, very strong, does not oxidize in the mouth and to be brief, it possesses all the requisite properties.

Now let us proceed to the technic of autogenous soldering for it goes without saying that a band for orthodontic purposes cannot be made in the same manner as a crown. Ordinarily when you want to solder autogenously you measure the exact length of metal necessary to completely go around the tooth and then cut your metal slightly longer than the measurement, bevel one of the ends or sometimes both ends so as to form a bias joint. By heating

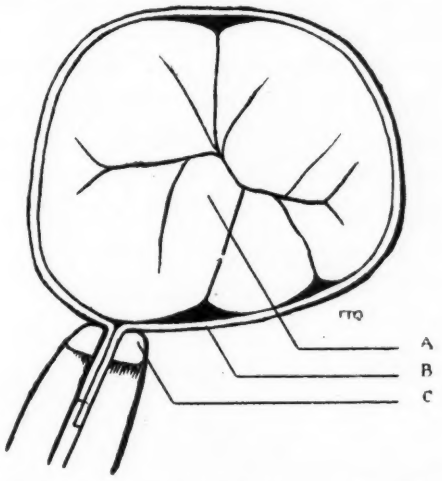

Fig. 1.—Formation of band. *A*, Mandibular left molar. *B*, Gold band. *C*, Angle's pliers.

the thickest portion first, due to capillary attraction, the heat is conducted along the molecules until it fills all the microscopic space which separates the ends to be united. This method is not convenient in orthodontia because it is impossible to obtain an accurate measurement because of the slight space necessary for passing the metal between the teeth. With children, it would be difficult to obtain the correct measurement even if the teeth were sufficiently separated to allow for the passage of a wire ligature between them.

When you wish to make a band for orthodontic use, the first step is to separate the teeth, not by means of discs which destroys them but by the use of silk ligature which displaces them without defacing them. Then you surround the tooth with a chosen metal and with the aid of Angle's pliers No. 123 (for making bands) which you grasp tightly when pulling the metal, you draw the band snugly around the tooth. (Fig. 1.) Then you solder the band, usually by placing over it a bit of solder sufficient to solder the joint.

But, if you wish to solder it according to my method, after removing the metal band carefully from the tooth, you diminish the length of the band about 1 mm. by straightening one of the folds made with the pliers and then carry it further back so as to render the band smaller. (Fig. 2.) If the tooth is found particularly difficult to band, you can refit a second time by stretching the gold band with the pliers, but in either case you must always shorten the band before soldering. Then you cut the ends so that they do not exceed 2 or 3 mm. beyond the band and now holding it underneath with your pliers,

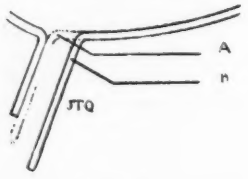

Fig. 2.

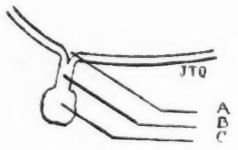

Fig. 3.

Fig. 2.—Shortening the band. *A*, Old fold. *B*, New fold.

Fig. 3.—Soldering the band. *A*, Empty V-shaped space. *B*, Joint soldered autogenously. *C*. Gold melted down during soldering.

making sure that it is in correct position and sides parallel, place it under the blowpipe. Now that the gold has turned red and the molten borax holds the two ends in place, grasp the bands opposite the joint in such a manner as to allow the edges to receive all the heat of the flame and watch for the fusing of the gold so that you can avail yourself of the moment when the joint becomes

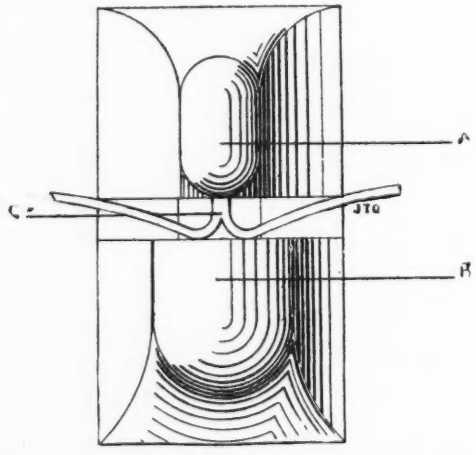

Fig. 4.—Eliminating V-shaped space. *A*, Round nose of pliers. *B*, Flat nose of pliers. *C*, Joint of the band.

filled with the molten gold. At this critical instant withdraw the band from the flame or you run the risk of melting it.

Upon closely examining a band thus treated, you will notice that the gold in fusing did not fill the gap completely but left a V-shaped space at the beginning of the joint. It is this defect that has caused me to look for a solution to the problem. The first few times I filled this space with solder, but then where is the advantage of autogenous soldering when you have to solder a second time?

I have overcome the difficulty in the following manner (Fig. 4) and completely do away with the V space: You cut the ends so as to project a little more than 1 mm. away from the band, then grasp the band between the jaws of a pair of contouring pliers No. 130 and so you flatten the parts entering into the formation of the V-shaped space in such a manner as to abolish the space and so straighten it completely. This stretches the band about 1 mm. and it is in anticipation of this preceding technic that we must diminish the size of the band before soldering.

The remaining preparation is done in the usual way. You burnish the edges against the tooth and grind the internal surface of the band slightly so as to permit for greater adhesiveness of the cement; then polish with discs of varying fineness and end the operation by burnishing the surface with a burnisher.

What advantages justify the use of this new process?

First; there is an economy of material, then you avoid the use of solder, finally the scraps can be employed in the laboratory for casting since they consist of naught else but 22 K gold and no solder, but these advantages are only secondary in nature. The true benefit derived from this process is that the joint is as strong as the rest of the band, also this process makes it possible to do successive solderings for attaching all sorts of accessory parts to the band without fear of opening the joint during these operations. Then, coming to a detail, to be sure, but nevertheless a detail of importance to those who wish to work properly and do honor to their professional title, that is, that this process allows you to finish your band so that it appears to be cast in one piece and thus does away with any trace of a joint.

This process allows for the making of a very strong band. I have not yet seen a band made in this way, break at its joint. It is easy to make bands for anterior teeth by this method, the only difference being that you use a thinner metal and also before soldering you do not diminish its size as much as with a band of thick metal. Lastly, this process permits of making bands for crowns and bridges rapidly and there is no reason why they should not be as strong as those made by the usual method. I always have to mention the fact that I confine myself to dentofacial orthopedia and so have not contributed anything toward the perfecting of crowns.

Demonstration.

Autogenous soldering of bands.

Dr. James T. Quintero ended the meeting by giving a practical demonstration of his method of soldering, autogenously, bands for orthodontic appliances.

DEPARTMENT OF
ORAL SURGERY AND SURGICAL ORTHODONTIA

Under Editorial Supervision of

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THE ORAL SURGEON'S POSITION IN DISEASES OF THE MAXILLARY SINUS*

By Theodor Blum, D.D.S., M.D., (Penn.), Universae Medicinae Doctor (Vienna)

Director Department of Oral Surgery, New York Throat, Nose and Lung Hospital; Oral Surgeon, Hebrew Orphan Asylum of the City of New York; Associate Oral Surgeon, Dental Service to Bellevue Hospital; Cons. Oral Surgeon, Hospital for Joint Diseases.

IN A paper entitled "Oral Surgery for the General Dental Practitioner,"† the following statement is found: "Dentists as well as Oral Surgeons (unless they also specialize in nose and throat work) will save themselves a lot of annoyance by only treating infections of the maxillary sinus of dental origin, otherwise they may drain a sinus for months while it is continuously reinfected through the nose or adjacent sinuses." An attempt will be made below to discuss diseases of the maxillary sinus of dental origin and to prove the previous assertion.

It is quite important to describe first, those deviations of the normal anatomy of the maxillary sinus which must be considered in their treatment by the oral surgeon. As a rule the apices of the maxillary second premolar and first molar are nearest the floor of the antrum. While the lowest part of the sinus is usually on the same level with the nasal floor, a marked absorption of the bone in that region will cause the formation of an alveolar recess or sinus (sinus alveolaris) which in extreme cases may involve the hard palate as a palatal recess or sinus (sinus palatinus) and extend mesially to even below the nasal floor. Then, of course, the apices of the first premolar and canine or even the two centrals may be quite near the sinus floor.

A small antrum is due to lack of absorption of bone, especially in the

* Read before the Meeting of the Bergen County Dental Society of New Jersey, March 13, 1922.
†Written by the author and published in the Dental Outlook, April, 1921.

region of the alveolus and the anterior wall. Depression of this wall as well as the bulging externally of the lateral wall of the nose may also be responsible for the reduced size of the antrum. Retention of a third molar or a canine occasionally causes the same anomaly.

Complete division of the antrum by a vertical wall has been reported, but is very rare. If a maxillary sinus appears to be divided by a horizontal wall, the lower part is most likely a cyst and the upper part the antrum displaced by the former.

According to Hajek the most frequent causes of antrum disease are the infectious diseases and of these especially influenza. Less frequent are the ones which develop secondarily from diseases of the teeth, maxillae and after injury. Only the treatment of the second class, with few exceptions, belongs within the sphere of the oral surgeon. The acute cases, of dental origin, may be caused by an acute purulent pericementitis, acute periostitis and acute osteomyelitis. The symptoms of the first are well enumerated by Hajek as consisting of severe toothache, pain upon pressure, elongation, frequently accompanied by periosteal swelling, and later on, discharge of foul smelling pus from the nose. When the offending tooth is extracted a communication with the antrum is found. Referring to periosteal swelling as a sign proves that only rarely is there found an infection of the bone or bone marrow without involvement of the periosteum and vice versa, so that when acute periostitis is given as another cause, it is understood that the bone itself must be also involved to cause an acute infection of the sinus. Although at times a communication with the antrum is established upon the removal of a sequestrum which had formed after an acute osteomyelitis, the sinus itself may be found to be healthy. The chronic cases follow chronic apical pericementitis whether the result of dental treatment or developing without such. Hajek has shown that infection may not only travel through the antrum membrane into the sinus, but also through bone of various thicknesses. He saw only two cases where infected cysts had broken into the antrum. The author has seen only one case of this type namely, a follicular cyst originating from a supernumerary tooth, which during an acute attack had involved the maxillary sinus. Chronic empyemas associated with tumors, syphilis and tuberculosis are rare. Under traumatic causes must be mentioned fractures as well as foreign bodies.

The normal antrum lining consists of a thin membrane made up of stratified ciliated epithelium and a glandular and periosteal layer. The rhinologist rarely has an opportunity to see a normal antrum lining. The oral surgeon, however, more often brings it to view during the surgical removal of a tooth or root as well as at the time of a root amputation or when removing a tumor of the maxilla; it appears thin and shows a bluish hue. During an acute empyema, the antrum membrane is swollen and red and the secretion scanty in the beginning, while later on it becomes mucous and purulent in character. When diseased the membrane becomes thickened, loses its transparency and appears whitish. Upon opening into a chronically inflamed sinus the antrum membrane is often found covered by mucous cysts and polyps.

The existence of a so-called hydrops antri is doubtful, only one case having been reported so far (Dmochowsky). By "hydrops antri is meant the accumulation of free serous fluid of inflammatory origin in the antrum where through a closure of the normal opening pressure within results in dilatation of the walls" (Hajek).

The most positive of both subjective and objective symptoms of empyema is the presence of pus in the antrum. Foul smelling discharge is characteristic of the dental origin. If the offending tooth is removed it usually disappears. It may drain anteriorly and be discharged through the nose especially when bending forward or may drip backward and then be eliminated through the mouth. The throat is usually dry and the discharge from it is especially noticeable in the morning but may also continue all day. Pain is especially typical of acute dental empyema when beginning as periostitis of the alveolar process or maxilla. There is also pain in the region of the frontal process of the maxilla and the patient complains of frontal headaches. He is conscious of a foul odor. If the sense of smell is diminished or lost, marked changes in the nasal chambers must have taken place. Nasal breathing through the affected side is impossible. The cheek will never be swollen or red unless the bone or periosteum has been primarily involved and diseased, when the mucous membrane of the mouth will also be swollen and red. Secondary involvement of the bone is extremely rare. Chronic distention, apparently of the antrum walls, but in reality of the outer plate of the maxilla in the region of the alveolus, buccally as well as of the palatal plate palatally, is due to the formation of dental cysts. They rarely develop within the antrum. In the author's case of this type cyst membrane was entirely surrounded by a bony wall. (Fig. 1.) Only in neoplasms occurs a true dilatation or distention of the antrum walls. In acute cases chills and fever are present.

In most cases, as previously stated, there will be a discharge of pus from the nose (coming from the middle meatus) or posterior into the nasopharynx. The discharge of pus, as a rule, appears at intervals. On account of the high position of the ostium, a definite period of time is required for the secretion to refill the antrum after having been emptied. Lowering the head encourages the flow of pus from the ostium although the possibility of it coming from one of the other sinuses especially frontal and anterior ethmoids must be excluded. If an alveolar opening is present, irrigation will reveal the presence of pus in the normal salt solution flowing from the nostril. If the ostium maxillare and accessory ostium are occluded by an inflammatory process, the antrum can be irrigated even through a small opening in the alveolar process by means of a return flow catheter. Transillumination as well as x-ray examination are quite important in making a diagnosis. Other methods used for diagnostic purposes like irrigation through the ostium maxillare or accessory ostium, through the punctured inferior or middle meatus belong in the field of the rhinologist.

One must always keep in mind that the maxillary sinus may contain pus without being actually diseased (pyosinus maxillaris). In these cases the antrum is a reservoir wherein the secretions most often of a diseased frontal

sinus accumulate. Cysts of the maxilla particularly the ones in the molar region (Figs. 2 and 3) may give the impression of an empyema, especially so if the bony wall which usually separates the cyst and antrum has disappeared and only a membranous wall exists. In these cases pus may discharge from an oral fistula when the patient's nostrils are held closed and the patient is asked to blow through the nose. However, upon irrigation,

Fig. 1.

pus will appear through the fistula but none through the nose nor will there be a history of discharge from the nose or throat, unless nasal disease is present or the antrum simultaneously affected. Osteomyelitis of the maxilla as well as malignant tumors of the antrum must be differentiated.

In cases of maxillary sinus infection, especially of an acute nature, non-vital molars and premolars should surely be subjected to dental treatment first if a fair degree of success is to be expected, but even in vital teeth deep

alveolar pockets should not be overlooked as an infection of the sinus can even take place through the bone. In the presence of an alveolar and palatal sinus, not only molars and premolars but also canine and incisors must be considered.

The treatment of maxillary empyema is based on the removal of the cause (diseased tooth, etc., foreign body) and the establishment of free drainage. Of the conservative methods, only two should be employed by the oral surgeon, namely, the operation through the alveolar process (Cowper) and

Fig. 2.

the one through the canine fossa. The radical methods of which the Luc-Caldwell operation and its modifications are mostly practiced at the present time, consist principally of the operation through the canine fossa with the establishment of a counteropening through the lateral wall into the nose. It belongs entirely within the field of the rhinologist although the author has often operated simultaneously with the rhinologist, each restricting himself to his own field.

The operation through the alveolar process may be difficult or contraindicated in such cases where the palate is high, when a considerable thick-

ness of alveolar bone intervenes between the apices and the antrum floor. For obvious reasons a deep canine fossa as well as an outward bulging of the lateral wall of the inferior meatus will be a contraindication.

The main objection to an operation through the canine fossa is the possibility of cutting the blood and nerve supply of the anterior teeth as well as actually injuring the teeth themselves. The best view, however, can be obtained through this operation only. All the oral operations can be performed under local anesthesia. If a tooth or an old socket has been found

Fig. 3.

to be the cause of antrum disease, the socket (after removal of the tooth) must be enlarged without injuring the adjoining teeth. For better inspection, diverging incisions will have to be made buccally, the posterior one running backward and upward and the anterior one forward and upward. The soft tissues are now retracted and the outer wall of the antrum with antrum membrane removed with care so as not to injure the apices of the teeth. The contents of the antrum are now removed and if the membrane itself is covered with polypoid tissue it is thoroughly curetted but the membrane never entirely removed. The mucoperiosteal flap is now replaced and sutured into position and an iodoform gauze drain inserted through the alveolar opening.

The iodoform drain is removed after forty-eight hours or earlier if necessary, and not replaced, so that the small alveolar opening may close as soon as possible. In the average chronic cases, this treatment including daily irrigation with warm normal salt solution either by the doctor or the patient, will be sufficient and the case discharged in about three to four weeks. Sutures are removed within five or six days. Should the secretion return at a later date and the antrum membrane again show signs of degeneration, a radical operation in cooperation with the rhinologist is indicated. While considering

Fig. 4.

chronic cases, the question of persistent openings into the antrum may be discussed. In some rare cases, the removal of the epithelial lining covering the tract followed by curettage of the same will be successful. The wound itself can be protected by a small piece of iodoform gauze placed over it and held in position by a figure-eight wire attached to the adjoining teeth or to an artificial plate or some mechanical appliance. Usually, however, the old time flap operation consisting of covering the opening, after it has been properly prepared, with a palatal flap and suturing it into position, is indicated. An obturator with a plug running through the opening into the antrum must be

condemned for several reasons. If the patient refuses an operation, an artificial appliance covering the opening is advisable.

The treatment of all acute cases is, from the standpoint of the rhinologist, expectant, in other words, by irrigation. Only the dental cases form an exception as a tooth may have to be extracted, a periosteal abscess incised, a sequestrum removed or a foreign body taken out. The removal of a root should always be attempted through the socket from which it came by enlarging it

Fig 5.

as outlined before and attempting to locate the same by inspection or with an instrument. If not successful, irrigation is the next step, during which the root at times even appears through the nose in cases where the ostium is large and the root itself small. Should this method not succeed then the mucoperiosteal flap and removal of the outer antrum wall must be resorted to. In either case, if the antrum is healthy a piece of iodoform gauze placed over the wound and held in position by a figure-eight wire encourages the quick closure of the opening. If, during an operation the antrum membrane is exposed but not pierced, no further treatment is necessary. Should, how-

ever, the membrane be pierced and the antrum opened into, it must be irrigated at the time of the operation if there was a possibility of debris entering the antrum. If dressing of the wound is indicated, the iodoform gauze must not be placed into the antrum but just so that it will cover the opening. In all these cases, the patient should be warned not to blow the nose for cleansing purposes, but only to wipe same, so as not to disturb the bloodclot and gauze.

The following cases of foreign bodies in the antrum may be of interest:

M. R., male, twenty-seven years of age (October 20, 1916), had been suffering from left maxillary sinusitis for several years. A radical operation was performed by a nose and throat specialist. There was also an opening into the oral cavity in the region of the premolars, through which opening, the patient was instructed after the operation to irrigate the antrum with a glass syringe. The opening naturally became smaller in due time, and the patient, who was a dentist, felt that the nozzle of the syringe was too long and proceeded to make a mark with a file at the point where he wanted to shorten it. While he did not succeed in breaking off the end at the mark, it did break off while he syringed the antrum, and remained in the antrum for seven years. When operating for its removal the piece of glass was found in a recess near the malar bone. (Figs. 4 and 5.)

E. M., male, thirty-four years of age (June 21, 1918), had antrum disease ten years ago, when part of an obturator was broken off in the antrum. Pus discharged from the nose and fistula in the right maxillary first molar. After removal of the rubber tube and curettage of the maxillary sinus the patient was discharged in due time.

It is quite difficult at times to establish the fact that some dental or maxillary condition is the cause of the inflammation of the antrum. But even if this is established, it will be necessary to have all the sinuses examined by means of the x-ray and have the nose, throat and sinuses thoroughly gone over by a rhinologist. If other sinuses, especially of the same side, are affected, a simultaneous operation by both the rhinologist and oral surgeon will be indicated. Acute and emergency cases are the exceptions. Inflammations of the maxillary sinus not of dental origin are cases for the rhinologist and not the oral surgeon. The patient's welfare must always be uppermost in our mind and, therefore, the statement expressed above should be generally recognized. It is unfortunate indeed that some antrum cases must be treated through the mouth. The natural opening of the maxillary sinus leads into the nose and the logical treatment, therefore, should be through the nose. It would be absurd on the other hand, if an empyema of dental origin were treated through the nose when the tooth or root must be removed and the sinus, therefore, can conveniently be drained through the socket without disturbing normal relations in the nose. While the rhinologist and oral surgeon can serve patients best in their own field, the careful cooperation of the two can only be of additional benefit to them.

DEPARTMENT OF
DENTAL AND ORAL RADIOGRAPHY

Edited By
Clarence O. Simpson, M.D., D.D.S., and Howard R. Raper, D.D.S.

PLACING AND HOLDING FILMS IN THE MOUTH

PART 1: GENERAL CONSIDERATIONS. PART 2: TECHNIC BY REGIONS

BY HOWARD R. RAPER, D.D.S., INDIANAPOLIS, IND.

PART 1. GENERAL CONSIDERATIONS

THERE are more details in technic to be mastered in placing and holding films in the mouth than in any other department of radiodontic technic. The purpose of this paper is to teach some of the details.

In order that a dental radiographic image may not be distorted or false, three *positions* must be correct: (1) The position of the head, (2) the position of the x-ray tube, and (3) the position of the films in the mouth.

POSITION OF THE HEAD

When the patient is in a sitting posture (we shall not consider the recumbent posture here) the position of the head should be *straight up,* that is to say, the head should be in such position that the roots of the teeth are substantially vertical. Still another way to express the same idea, and perhaps the best way to express it, is to quote Simpson and say, "let the head be in such position that the *occlusal plane is horizontal.*"

It is hardly necessary to use a measuring device always to tell when the occlusal plane is horizontal. If, however, the operator wishes to make such measurement, as he may sometimes, particularly when the film is placed flat in the mouth, i.e., on a plane with the occlusal plane, he may do so by means of *"the Simpson occlusal plane finder"* (Figs. 1A and B).

The *Simpson occlusal plane finder* is, in principle, simply a flat plane equipped with a circular, or double, spirit level. The flat surface is held against the occlusal surfaces and incisal edges (Fig. 1B) and the head moved and tipped until the bubble of the spirit level registers center over the mark in the center of the circular spirit level.

POSITION OF THE X-RAY TUBE

The angle of the x-ray can be varied in two ways: (1) *vertico-horizontally* and (2) *mesio-distally*. Figs. 2A and 2B illustrate variations of the *vertico-horizontal* angle. Fig. 2C illustrates variations of the *mesio-distal angle.*

We need no measuring device to measure the *mesio-distal* angle. This

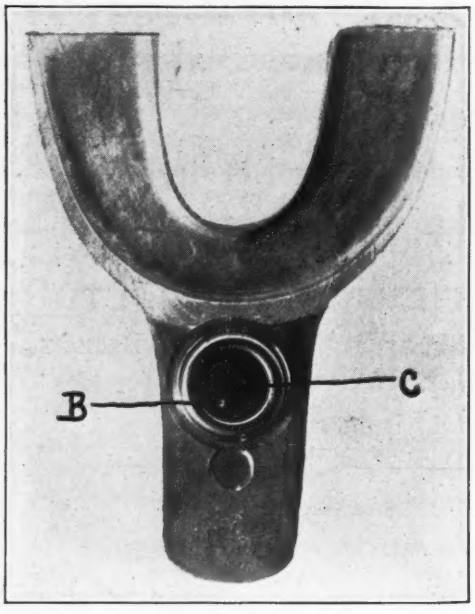

Fig. 1-*A*.

Fig. 1-*A*.—Simpson Horizontal Occlusal Plane Finder. (A "home-made" one. *B*, bubble in the circular spirit level; *C*, center mark in the spirit level.

Fig. 1-*B*.

Fig. 1-*B*.—Occlusal plane finder in use. The head is tipped and moved until the bubble in the circular spirit level registers center.

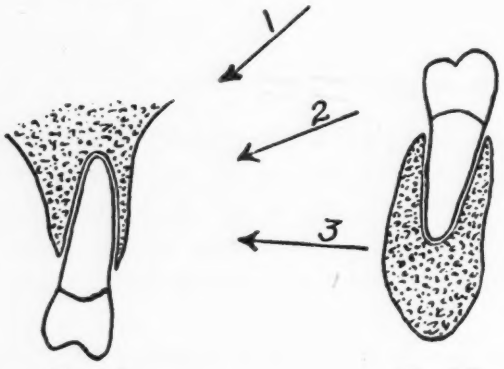

Fig. 2-*A*.

Fig. 2-*B*.

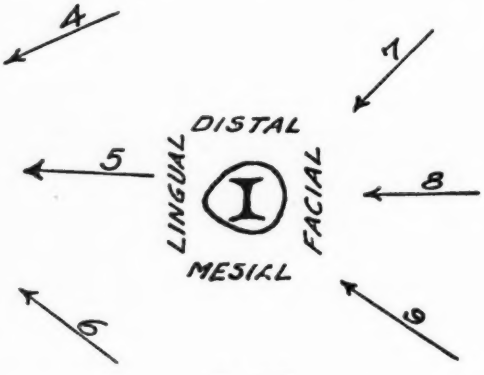

Fig. 2-*C*.

Figs. 2-*A* and 2-*B*.—Illustrating variations of the *vertico-horizontal angle;* also spoken of as the "*vertical* angle." (These angles are called the *vertico-horizontal angles* because they vary from the horizontal toward the vertical; they are designated as *vertical angles* because they are all in the same plane, i.e., a vertical plane.)

Fig. 2-*C*.—Illustrating variations of the *mesio-distal* angle; also spoken of as the "*horizontal angle*" because all of the variations of the angles are presumed to be on the same plane, i.e., a horizontal plane.

angle of the rays is ordinarily straight through the teeth from facial to lingual, or, to express the same idea differently (and quote Simpson), "parallel to the plane of the proximal surfaces of the teeth."

Different teeth require different *vertico-horizontal* angles. To save time

and effort and avoid unnecessary uncertainty, some sort of angle-measuring device is necessary to determine the vertico-horizontal angle. Figs. 3A, 3B, and 3C illustrate a rough working model of an *angle meter* of my own design. This *angle meter* can be attached to any cone or cylinder. It is seen in the

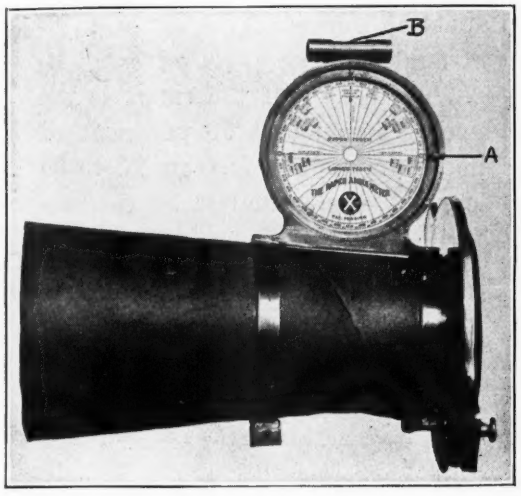

Fig. 3-*A*.

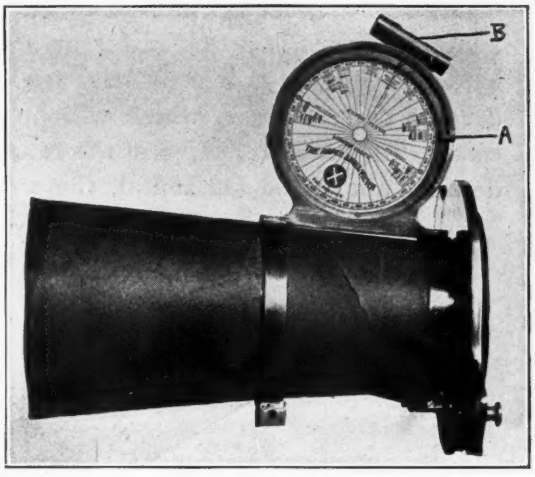

Fig. 3-*B*.

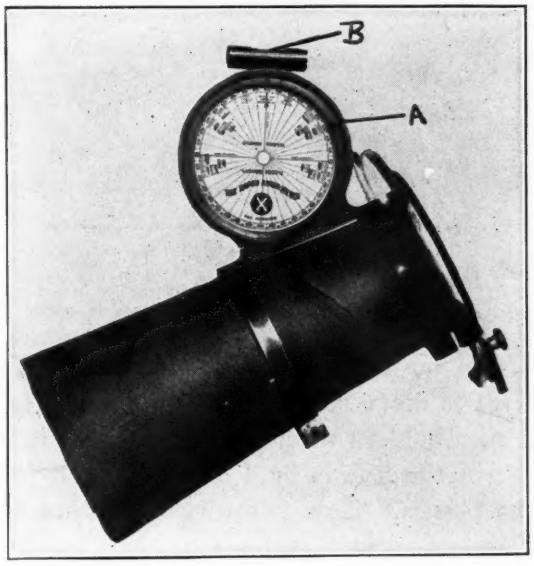

Fig. 3-*C*.

Figs. 3-*A*, 3-*B*, and 3-*C*.—A crude working model of the Raper *angle meter*. In Fig. 3-*A* the indicator "A" points to zero and the angle of the x-rays is horizontal. In Fig. 3-*B* the dial has been moved to an angle of 30 degrees above the horizontal (an average angle for maxillary molars) that is to say, the meter is "set" for an angle of "30 degrees above." In Fig. 3-*C* the cone has been tipped until the spirit level, B, registers center; that is, until the cone (and so the x-rays which would pass through it) is tipped at an angle of 30 degrees above the horizontal.

When the cone has been tipped to give the angle for which the angle meter has been set, the operator must make it a point not to change this angle. The focal ray may be centralized by moving the cone (and so the x-ray tube) up or down or sidewise, but the vertico-horizontal angle should not be changed. (The focal ray is a more or less imaginary x-ray passing from the center of the focal spot through the center of the cone or cylinder. This ray should also pass through the center of the part being radiographed and strike the center of the film.)

Since the meter illustrated here was made a number of alterations have been made in the markings on the dial.

illustrations attached to a cone. For the technic of the use of this angle meter see the legends under the illustrations.

POSITION OF THE FILM IN THE MOUTH

If the films are placed in the mouth always in the same way and in as close apposition to the tissues as possible, then the only variation in position of films which occurs is due to variation in anatomic forms. This variation in anatomic forms is provided for by a *range* of angles on the *angle meter.* The extent of the *range* is ordinarily ten degrees. The center of the *range* is the *average correct angle,* which will be found correct in about 90 per cent of cases. To elucidate, suppose the range for maxillary molars is from 25 to 35 degrees above the horizontal, the average correct angle then is 30 degrees

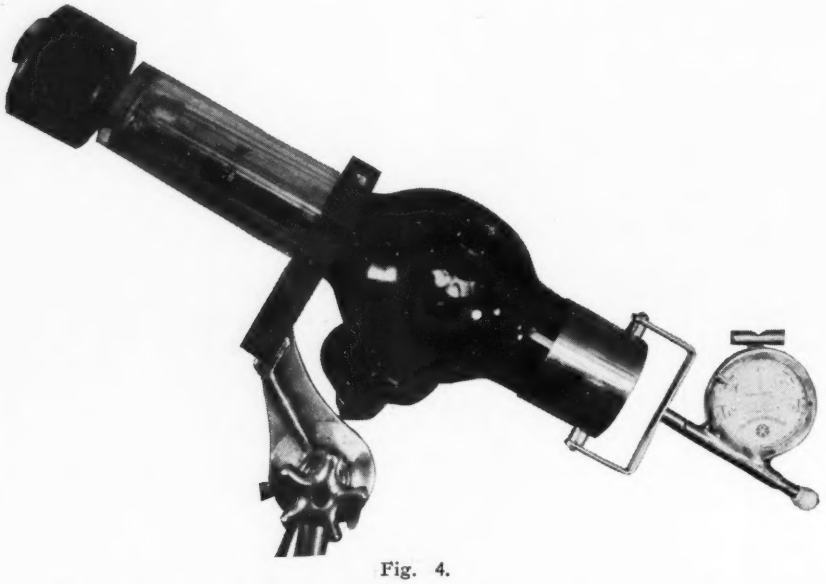

Fig. 4.

Fig. 4.—The *angle meter* mounted on a focal ray indicator or pointer. The pointer and angle meter swings to the side when the angle is correct and the operator is ready to make the exposure.

above the horizontal. In the case of the maxillary molars there is a *permissible extension of the range* down as low as 20 degrees, in selected cases.

I do not use the film holders which hold the film flat, i.e., which prevent bending the film. When the film is held flat, it cannot be brought into uniform contact with the tissues. Thus two of the fundamental laws of radiography are violated: the one which states that the film should be as close to the object being radiographed as possible, and the other which states that the best relative positions for film, "part," and x-ray tube are to have the film and part parallel and the x-rays striking both at right angles, and *not to depart farther from this ideal arrangement than necessary.* (The use of the flat film holder necessitates a more diagonal x-ray angle. There is therefore more chance of distortion and shadow misrepresentation.)

DIFFERENT WAYS OF HOLDING FILMS

The following is the history of the different methods I have used to hold films in the mouth. First I held them myself, but stopped this almost as soon

as I started it. The practice is dangerous, unnecessary, and wrong. Next I had the patient hold the films for both maxillary and mandibular teeth. Then I commenced to use film holders for the mandibular teeth and the patient's thumb for the maxillary teeth. I considered it an advance in technic when I discontinued having the patient use the fingers to hold upper films and had them use the thumb only. It was also a bit of hard-earned knowledge to learn to direct the holding force of the patient's thumb "straight up"; this kept films from slipping downward. The following holders were used for the mandibular teeth: (1) A modified Kny-Scheerer holder, (2) the Heidbrink holder,

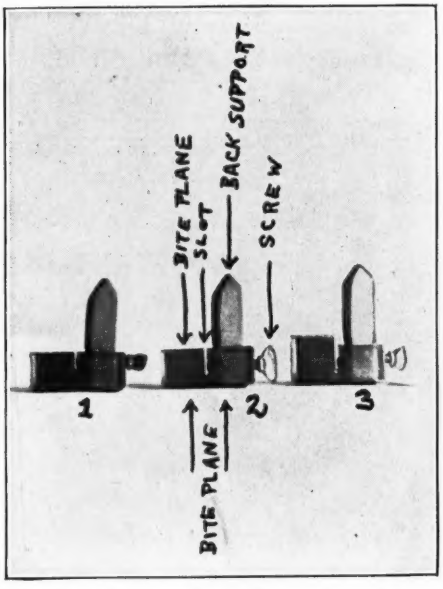

Fig. 5.

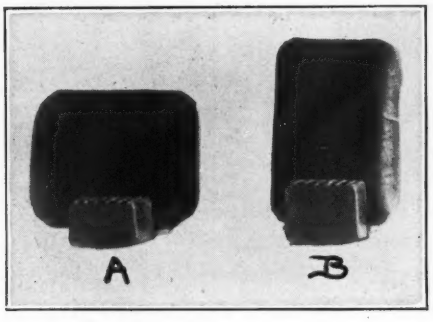

Fig. 6.

Fig. 5.—A set of three universal film holders. All the films for Figs. 13 and 14 were held in the mouth with these holders.

No. 1. If the use of these holders causes undue discomfort, it may be due to the fact that the rubber back support is too long; cut it off. The average correct length of the rubber back is ¾ to ⅞ inch. Holder No. 1 may be used for the maxillary teeth, with the film crosswise for the posterior teeth and lengthwise for the anterior teeth. Also it may be used for all the mandibular teeth—if the floor of the mouth is low enough—with the film packet placed crosswise. (See Fig. 6 for explanation of meaning of "crosswise" and "lengthwise" as used here.)

Holder No. 2 is identical with No. 1 except the slot is deeper. Therefore, it does not force the film packet as far rootwise. It may be used the same as holder No. 1. Because it does not force the film pack so far rootwise it is an easier holder to use.

Holder No. 3 may be used with the film lengthwise for the mandibular anterior teeth, as well as in regions where teeth are missing. It may also be used in cases of horizontally impacted mandibular third molars where holders No. 1 and No. 2 force the films down so low that we do not get a radiographic view of the tissues above the impacted teeth.

(3) the Schaffer-Pierce holder, and (4) for the mandibular front teeth, for a while, the Leach holder.

UNIVERSAL FILM HOLDER

Recently I have used a set of three holders (Fig. 5) for all parts of the mouth. All of the films for Figs. 13 and 14 were held with these holders. They may be made of metal or some radiolucent material. The advantage of the radiolucent material is that it does not leave a deep radiopaque mark on the finished negative.

The "back support" (Fig. 5) is of flexible rubber (or it may be a spring). It is this feature that makes the holders practical for the maxillary teeth. The rubber will "give" as may be necessary to get the film and holder in place; the rubber will also hold the film in apposition to the tissues.

Note that the distance between the bottom of the "slot" (Fig. 5) and the top "bite plane" is different in each holder; it is greatest in No. 3 and least in No. 1. The shorter this distance (slot depth) the farther the film packet will be pressed rootwise. Thus, for example, if the floor of the mouth is deep, the operator would choose holder No. 1 (for the posterior teeth), while if the floor of the mouth was not so deep, he would select holder No. 2.

Films may be placed *crosswise* (Fig. 6A) or *lengthwise* (Fig. 6B) in the holder and so placed either *crosswise* or *lengthwise* in the mouth. (By "cross-

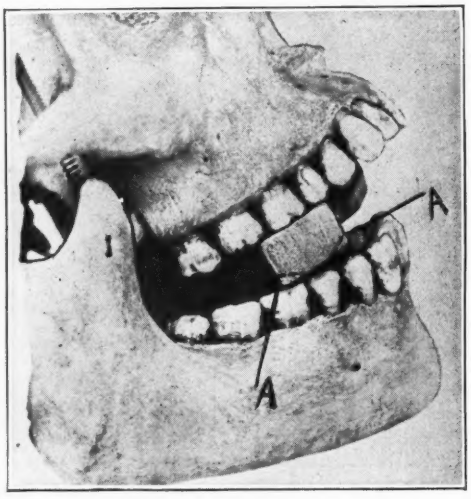

Fig. 7.

Fig. 7.—The lower teeth touch the holder only at the extreme posterior edge. The force of biting would cause the holder to tip downward in front. This is prevented by beveling as indicated by the dotted lines *A*. Both ends of the bite plane are beveled so the holder may be used on either right or left side, maxillary and mandibular, without tipping.

wise" is meant that the long way of the film is at right angle to the long axis of the teeth. By "lengthwise" is meant that the long way of the film is parallel with the long (axis) way of the teeth.)

Another feature of these holders is the "beveled bite plane." Fig. 7 shows a holder without the bite plane being beveled. Read the legend under Fig. 7.

The screws in the holders (Fig. 5) hold the film packet immovable in the slot.

ADVANTAGES OF FILM HOLDERS OVER THUMB OR FINGERS

The following are some of the advantages of the Universal Film Holders over having the patient hold films with the thumb or fingers (Figs. 8 and 9):

1. Slipping (movement) of the films is less likely to occur.

2. Gagging is less likely to occur. (This, because the films are not pressed *so hard* against the tissues, and because "slipping" does not occur.)

3. It is less difficult and requires less time to place and hold a film packet with the film holders.

4. There is not the danger of placing the film *too far* rootwise or *not far enough* rootwise when holders are used.

5. There is less danger of getting the shadows of the teeth on the film at an oblique angle when the holders are used. See Figs. 40A and B.* (The objection to having the teeth on the negative in an oblique manner other than that parts of the teeth may be missed, is that such negatives do not have a good general appearance.)

6. In some cases of rheumatism, where the patient cannot raise the hand, and in cases of palsy when the patient cannot hold films with the thumb or fingers at all, but can hold the films readily enough with the teeth by means of film holders.

(*To be continued.*)

*To appear in a later issue.

INDICATIONS FOR RADIODONTIC EXAMINATIONS*

By L. R. Main, D.D.S., St. Louis, Mo.

WHILE the use and advantages of the x-ray in practically every department of dentistry are well known to most of us, still it is well and perhaps advisable to spend some time in a review of the indications of its use, before the different phases of the subject are presented by the other men on the program in this department.

The advent of radiodontia is perhaps one of the most welcome of the recent developments of dental science by the more careful and scrupulous men in our profession, and is perhaps the most condemned and ridiculed of all the newer things which have taken their place in modern dentistry by men who are inclined to laxity in their work and who are afraid of the truth, as frequently revealed through an x-ray examination, when this examination is done conscientiously and with precision. Because it is so frequently improperly done, because sometimes our information is limited and sometimes the patient will resent resorting to the use of the x-ray as an aid in diagnosis because of fear, or expense, is no reason for our not agreeing with the most advanced thinking of the profession on these grounds, and ascertaining all information possible in every case.

Whether we all agree as to the use of the x-ray in our work, whether we hold the opinion that because of the few mistakes that are made, we will have nothing to do with the radiogram, the use of the roentgen ray as an aid in dental practice has come to stay, at least, until something new is discovered or invented which will give us more light on dental disturbances than has been possible to secure with the radiogram. Regardless of how prejudiced we may

*Read before the Tri-State Dental Meeting, Kansas City, Mo., April 10-15, 1922.

have been, or still are, I am sure we will all concede this as true, and yet the application of x-ray findings in the average office is barely in its infancy.

Since the x-ray can be used, and is used, in every department of dental practice, save, perhaps, some phases of prosthodontia, and as Dr. Raper states in his recent book "there are over sixty distinct and definite conditions revealed by the radiograph which cannot always be determined by any other means," surely it behooves us to consider just a few of its many phases.

The only possible excuse for ever resorting to an x-ray is to get information and this information is to aid us in making a diagnosis. The value of the roentgen ray as an aid in making a diagnosis in everyday practice is invaluable, not only to locate the usual foci of infection, which is common to us all, but also in determining any abnormal condition about the oral cavity which might be an etiological factor in other manifestations. We are usually so engrossed while looking at a film in finding dark spots at the root ends that when the so-called areas of rarefaction are not found, or upon the use of the vitality test all the teeth are vital, we are apt to give a negative report, forgetting the other valuable information, which is frequently found by the use of the radiogram.

If dentistry is to continue to grow in its possibilities; if we are to serve humanity to the full extent of our opportunities; if we are to solve the problem of oral sepsis and perhaps eliminate many constitutional disturbances; and if we are to conserve health, also time and needless expense to our patients and to ourselves, we will have to proceed on the fundamental principles of oral diagnosis. I realize from my own experience the weakest link in the whole chain of dentistry is in the lack of our appreciation of the value of diagnosis. You may say, "I always make a diagnosis before I commence dental work of any nature." If so, I am glad, indeed, for you, but I repeat, from my own experience, the weakest link in the whole chain of dentistry is in our diagnosis.

To my mind there never was a time which required so much common sense to practice as the present. Which method are we to follow is ever the question when we consider diseased teeth. From the articles we find in dental literature we are almost as much at sea as we were three years ago. Still, through it all, we have more light by which to work than in any previous time and I am sure dental diseases are better understood. Before any treatment which involves the vascular tissue is started, it is always advisable to know the condition of the underlying structures as well as that which we observe in our clinical examinations. Here is where the use of the x-ray plays the important part. While the radiogram is only one of the means in aiding us in our work, it is the most potent factor we have in making a diagnosis. While the use of the radiogram may be abused and sometimes is, and while many condemning statements can be justly made from the patient's viewpoint, still in spite of these the intelligent use of the x-ray in dental practice has done more to revolutionize dentistry and stimulate better dentistry than any other one factor. Yet many men fail to avail themselves of this important asset in determining dental conditions. It is as necessary to

resort to an x-ray in making an intelligent diagnosis as it is to have a casting machine to make a perfect fitting gold inlay. If our dental operations are to be successful, our diagnosis must be fully and carefully made.

If our information has increased, then our responsibility has also increased. We are expected to step up into the light we now have. As dentistry is becoming more and more exacting, the problems with which we now come in contact are more serious. There has been a responsibility shifted to the shoulders of the profession which we must assume, and that responsibility is the conservation of health. The first requisite in accepting this responsibility is knowledge. Knowledge of physiology and anatomy, especially pertaining to the oral cavity; knowledge of the fundamental principles of pathology and surgery; knowledge of the general disturbances which could be of dental origin, either as a result of infection or reflexes, from abnormal pressure on nerves. How are we to determine these possibilities without the use of the radiogram? So far as the future is concerned, by the aid of the radiogram we can prevent much of the trouble, which we now find has developed as a result of insufficient light by which to work a few years ago.

If an ounce of prevention is worth a pound of cure anywhere it is surely true in dentistry. The wealth of a nation depends very largely upon the health of the individuals who compose that nation. A person's success in the world depends on his ability to keep well. Preventive medicine, in some degree, depends upon our ability to take care of dental disturbances. How can we take care of these disturbances intelligently unless we know the condition of the whole tooth and adjacent tissues? Are not our patients entitled to the full truth, so far as it can be secured, should any of the usual means at our command be withheld when a diagnosis is desired?

If the x-ray is as valuable in dental practice, as men who are in the habit of using it would have us believe, are we ever justified at guessing in any of our work when the light of the x-ray would eliminate about 75 per cent of this guess work; for example, the length of a root of a central incisor, the canal of which we expect to fill just to the apex?

I believe before we, as a profession, can approach the possibilities of our endeavors, we must have a new vision of our responsibility. In practically every case (of adults especially) coming to us for treatment, unless it is emergency work, we must spend at least as much time on our diagnosis as we ordinarily do on restoring a tooth with amalgam. We must quit treating a tooth two or three times and say if it does not respond, we will then make a radiogram, which is another way of saying, we will diagnose your case. Generally speaking, the first thing a progressive physician does when called on a case is diagnose, then prognose, and prescribe. I would go further and say we must diagnose the whole mouth, all the teeth, which includes the use of the x-ray in practically every case. The condition of the whole usually materially influences the prognosis and treatment of the few which may be diseased. We too frequently spend hours of time on beautiful carvings of inlays and other restorative work (which in itself is all right) when no direct

attention was first given to secure information as to the condition of the root ends of the tooth before our restoration is started. How often have we all heard it said, "I recently crowned this tooth which is now giving trouble, but I did not do the root canal work." If the x-ray had been used first, in many of these cases much of our embarrassment in this type of trouble could have been prevented. I maintain, any devital tooth on which you expect to place a crown or a filling, or to use as an anchor in supplying missing teeth, regardless of who devitalized the tooth, and even if it were done years ago and has had a perfect history, should be radiographed before the patient is asked to spend time and money on it. We fail in our efforts frequently, even today, and sometimes on patients who are suffering from metastatic infections because this is not done.

There has been a great deal in dental literature about physicians making recommendations regarding the teeth of their patients, which does not always coincide with the ideas of the dentist. In many instances teeth are extracted on medical advice with which we, as dentists, do not agree, and no doubt in altogether too many cases perfectly good and useful teeth have been sacrificed but what have we to offer in defense of our claims. We say the dentist should be consulted in all matters pertaining to the teeth, and their extraction should not be done without his advice. I most surely agree with this, in every case, *if* he has put forth the effort and the necessary time to make a complete dental diagnosis. But if the dentist has not used every available means in ascertaining the true dental condition, in many instances he has not sufficiently enlightened himself upon the conditions in the case to be reasonably sure of the possibility of some of the teeth not being detrimental to the health of the patient. The average physician is no more versed on dental pathology than most of us are on general pathology. If we commence to talk dental nomenclature we are not fully understood by our medical friends. To my mind the most tangible thing to present, that which is fairly well understood by both men, is a complete and thorough radiodontic examination. If one man is too anxious to extract this will check his overanxiety to remove all infections by removing all the teeth, and in doing so, needlessly remove good teeth in order to be sure to get the bad ones. To the other man who may be more conservative, it will also give additional information as to the true conditions and the advisability of extracting any teeth, and he will be in a much better position to attempt a prognosis, both local and systemic.

In this day when so much agitation for radiodontia is prevalent among the laity as well as medical men, it would be a safe practice to make a thorough and complete examination for all our patients as the occasion presents itself, and keep this record for future reference. Dental work now being done on questionable teeth without the use of the x-ray must be condemned.

The indications for radiodontic examinations are numerous, too numerous to indicate here every degree to which the x-ray can be used to advantage in the practice of general dentistry and in all the special lines of dentistry. Some of the indications must receive special consideration and

I must be extremely practical in these recommendations. I wish to say now that any man who is depending entirely on radiodontic findings for a diagnosis is almost as negligent of his duty to his patient as the man who entirely discards the information gained by the use of the x-ray. I am taking it for granted that a complete clinical survey of the oral cavity is made, that at least a partial history is secured from the patient as to general health, etc., and that the history of suspicious teeth is recorded. Now the conditions indicate the necessity for information as to what may be found in and around the roots, and adjacent structures. First, the importance of complete radiodontic examinations cannot be emphasized too strongly, for in most cases the only way I know to tell whether a complete x-ray is necessary is to make the examination first and then you are in a position to decide if it were necessary.

Too frequently we are of the opinion, if the teeth respond to the vitality test, that the x-ray is counterindicated. If there are no apical abscesses, we must not think there is nothing else to be revealed by the x-ray and the examination is superfluous. On the contrary, many conditions may be found which can and do influence the general health and may be responsible for local disturbances as well.

Perhaps the most frequent use of the radiogram is to determine the periapical condition of devital teeth. There are some who claim they are able to satisfactorily determine this by palpation and clinical findings, but I am frank to admit my inability in these lines. For myself, I know it is absolutely necessary to use the radiogram. If conservative treatment is deemed advisable on any tooth where the destruction of tissue is evident, we must determine as far as possible the number of canals, their shape, length, and possibility of access to each canal. According to the best information on root canal work, diagnostic wires should be placed in the canal and another radiogram made, then the canals should be filled and a check-up made to determine the results of filling. In order to further determine the success of our efforts, at least another check-up is advisable in from three to nine months, depending on the conditions, to note the regeneration of bone. While to many this sounds too extreme for practical purposes and while I realize this is not always done and occasionally cannot be done, still I am of the opinion that if we are to serve humanity to the fullest extent, if we are to eliminate dental foci of infection, we will have to know the whole truth in all these disturbing conditions which at the present time is best revealed through the x-ray. Surely the responsibilities of the profession are increasing. Many mistakes in diagnosis, treatment and surgical procedure could be avoided by the intelligent use of the roentgen ray.

Perhaps one of the most important uses of the x-ray is in the treatment of vital teeth. We have learned that the chief source of dental infection is from teeth on which a dentist was called to operate on the pulp of a tooth, and largely due to the lack of knowledge the work was incomplete, and apical disturbances followed. We have also learned through the radiogram that when the root fillings are done thoroughly and asceptically, apical disturbances are

less likely to follow. So in our present root canal work, one of the chief advantages is that with the aid of the radiogram, most of our guesswork is eliminated as we can measure the length of the roots, ascertain their shapes, and check up the results of our efforts and see whether the work was properly done.

The exodontist must continually work with the x-ray, not only to locate unerupted and impacted teeth, but especially to determine that no root ends remain in sockets (Fig. 1) and that necrotic areas are properly cared for after extractions. In sockets from which teeth were removed but which failed to heal readily, we sometimes find that pieces of teeth, filling material, and broken instruments are responsible for the delayed healing. Or it may

Fig. 1.

Fig. 1.—Root remaining in the socket of mandibular first molar. Proved to be a third root.

Fig. 2.

Fig. 2.—Root end remaining, curettement necessary.

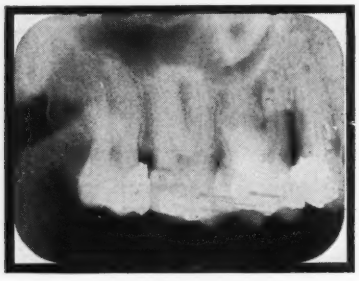

Fig. 3.

Fig. 3.—Cavity on distal of second molar responsible for indefinite pain through left maxillary arch.

Fig. 4.

Fig. 4.—Mandibular second premolar retained too long, responsible for reflexes through inferior dental to pneumogastric.

be a cyst was responsible for the loss of the tooth, and in most cases it is necessary to know the size of the area in order to remove the cystic wall. It seems to me in every case of gross destruction of bone around diseased teeth, the extent of the destruction should be determined, for if a curettement is advisable, usually the radiogram is our chief guide in determining the extent of the curettage (Fig. 2).

In cases of indefinite pain, especially along the course of the trifacial nerve, it is many times impossible to locate the cause of this trouble by other methods. I have seen many cases where teeth have been opened into, some even devitalized, and still the pain continued until the radiogram revealed an inaccessible cavity at or under the gum margin, an unerupted tooth,

usually a third molar, a supernumerary or hypercementosis, and in a few instances pulp stones were found to be the factor. How much time and pain could have been saved, had the radiogram been used in the beginning. (Figs. 3 and 4.)

In all cases of so-called pyorrhea, an x-ray is advisable and in well established cases, it is absolutely imperative to determine the extent of the destruction of the supporting tissues (Fig. 6).

Fig. 5.—Third molar causing pressure on inferior dental nerve, causing headache. Relieved on extraction.

Fig. 6.—Pyorrhea case. Clinically in fair condition. Radiographic findings very unfavorable.

Fig. 7.—Orthodontia. Supernumeraries.

Fig. 8.—Edentulous arch. Denture used for several years.

Fig. 9.—Unsuspected cyst. Impacted lateral which is most uncommon.

The radiogram has become indispensable in the practice of orthodontia. So many teeth which are not found clinically are revealed by the x-ray, their position located, their development noted, and usually the aid in a prognosis is of material advantage. The use of the radiogram sometimes materially changes the ordinary course of treatment in orthodontia, when it proves the tooth missing from the arch is also missing altogether from the mouth. Another advantage is, the information which can be secured as to the amount of space necessary to allow an erupting tooth to take its place in the arch. The presence of supernumerary teeth which are sometimes quite distressing, can easily be ascertained (Fig. 7).

A check-up on all large approximal fillings is advisable so that the cervical margin can be studied. The overhanging margins of amalgam, especially, frequently give rise to considerable loss of alveolar process as well as

the gum septum. A radiogram is likewise advisable in determining the position of the pulp where large restorations are to be made on vital teeth, and to observe the relation of the apices of upper posterior teeth to the antrum, as well as to aid in diagnosing disturbances in the antrum.

Some of the other conditions revealed by the radiogram, which occasionally come under observation, but which are not so common in everyday practice as the indications which we have just reviewed, are edentulous spaces with no history of extraction of permanent teeth. The condition of these spaces should be determined before any restorative work is started. Sometimes bridges have been placed on teeth to restore the missing organs and afterwards unerupted teeth have given trouble (Fig. 8). There are also some cases where entirely edentulous arches should be x-rayed. When every symptom in a general disturbance points to the presence of some focus of infection and every other examination is negative, it is sometimes found that root ends remain in the sockets of extracted teeth. There are also found in some instances supernumeraries, fully developed canines and third molars which were no doubt impacted in earlier years; and after dentures have been used for several years, these teeth have become disturbing factors and the radiogram reveals pathologic disturbances about these remaining teeth and root ends.

Other conditions are sometimes revealed which perhaps come more under oral surgery than general dentistry, such as fractures, cysts, temporomandibular disturbances, odontomas, etc., but these are not of such vital importance at this time as we are now considering the phases which we meet in everyday practice (Fig. 9).

While I have not attempted to cover everything revealed by the radiogram which is observed in dental practice, I believe the conditions mentioned will prove that the indications for the use of the x-ray in dentistry are so numerous that to even attempt to practice without access to this valuable aid for most of our work, is to be placed in an unfortunate position and one which will sooner or later lead to embarrassment and perhaps failure.

I do not wish to appear too severe or critical in any destructive sense, but I am anxious for all of us as dentists to be alert to our opportunities and responsibilities, to be constructive and not destructive in our dental operations and to practice rational and not empirical therapeutics.

RADIODONTIC RIDDLES

Conducted by Clarence O. Simpson, M.D., D.D.S.

A Department Devoted to Discussion of the Scientific, Technical, and Ethical Problems of Radiodontia

Officer, Give Him One More Chance

Q.—What is the best technic for treating pyorrhea with the x-ray, and how soon can results be expected? I have a —— unit which is said to be safe, so have been trying it on a few pyorrhea cases. It is easy for the front teeth by just having the patient hold the lips out, but it is hard to get the molars this way.

A.—Now, the suspense is ended, there is nothing worse to fear. Inadequate examinations and incorrect diagnoses fade into insignificance, when dentists meddle with radiotherapy. Since having the price is the only qualification at present required for a dentist to operate an x-ray machine (or introduce it to a cheap assistant), it is time for Dental Examiners to include the rudiments of radiology in their examinations for a license. How could they examine in radiology when * * * * * ? The same way they examine applicants in chemistry. Have some one prepare the questions or crib from a textbook, look wise, and balance on their authority. Your dear (mercenary) alma mater did not teach radiology or radiodontia? Certainly not, dental colleges follow the profession instead of leading it, but where did you learn radiology? Then what right have you to practice it? This thought is restricted from use by any liability insurance blackmailing white washers. Is

Fig. 1.—Calcareous deposit with extensive alveolar absorption on the lingual.

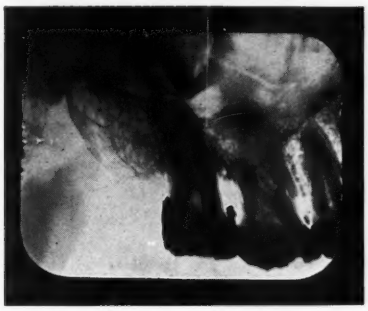

Fig. 2.—Projecting restoration contributing to periclasia.

it not queer how liability insurance is solicited by intimidation and fear of losing your "flivver" and scrap gold because you miscalculated in using 3 in 1 instead of 1-2-3 (figuratively speaking), but after paying tribute and being taken under the protective wings of a corporation you may practice septic dentistry and have your office girl give electrocution rehearsals with the assurance you will be exonerated of anything done in a dental chair.

The x-ray is a great diagnostic aid in the prevention and treatment of pyorrhea alveolaris, but its therapeutic value in this disease has not been established. Since everything from vapor to steel has been recommended for periodontoclasia, it would have been surprising if an agent so potent and mysterious as the x-ray had been ignored. It has not, and periodically an empirical account of unconvincing "cures" by x-radiation is published. Most of these articles originate in Europe, where experimental melodrama flourishes at the expense of clinical efficiency, and if a defective memory serves aright the sepulchral Dental Cosmos usually acts as American sponsor.

The reaction of tissues and organs to x-radiation is so astonishing that

Fig. 3.

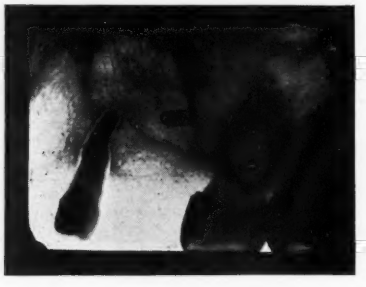

Fig. 4.

Figs. 3 and 4.—Typical thickening of periodontal membrane from traumatic occlusion. In these cases by denture attachments.

the possibility of periodontoclasia responding to this treatment is granted, but the complex etiology of the disturbance makes it unlikely. As a direct answer to your question, dismiss the idea, for the probable benefits do not justify the risk. Radiotherapy should be practiced only by those who have made a thorough study of the science. The present knowledge has been acquired by long clinical experience and at the cost of permanent injuries and lives. It is now passing through a period of radical changes with future developments problematical.

Your toy equipment is inadequate for any treatment excepting the removal of superfluous hair, and as a depilatory agent it probably would be a success. The only way you will cure pyorrhea with it is by removing the seat of the disease when the face "sloughs off." There is a useful field in periodontoclasia for the x-ray when it is applied to radiography. Incipient alveolar absorption may often be observed in radiograms before it is distinguishable by changes in the gingiva. Calcareous deposits, projecting

restorations, imperfect contact surfaces, loss of contact, and traumatic occlusion, all predisposing factors in periclasia are disclosed by radiodontic examinations. Successful treatment of periodontal lesions directly depends upon the early discovery and removal of the causes, and this service alone warrants periodic general radiodontic examinations.

In advanced stages of marginal destruction, the radiogram is a vastly more accurate means of determining conditions than instrumentation, contrary to the statements of some periodontists. Doubtfully assuming that the irregular line of destruction could be correctly charted by the digital diagnostician, the length of the roots and the amount of unimpaired attachment are unknown, and the mobility of teeth is not dependable evidence. One

Fig. 5.

Fig. 6.

Figs. 5 and 6.—Teeth retained by splints after complete loss of bone support.

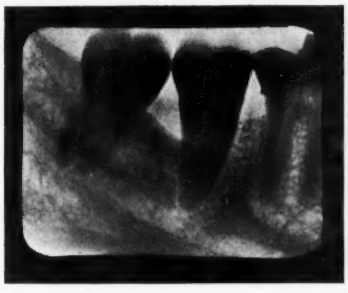

Fig. 7.—An illustration of how the line of bone destruction can be distinguished on different surfaces.

"pyorrhea specialist" who has said that radiograms were not necessary in his treatment, treats all teeth which do not fall out, and permanently dismisses patients as cured after a course of treatment and collection of the fee. The natural conclusion is that he wishes to protect his conscience by not knowing the extent of alveolar involvement and the deception which he is practicing.

Ignorant defamers of radiography say pyorrhea "pockets" cannot be seen in radiograms except on the mesial and distal surfaces. In the character of radiography which these men probably use, it is surprising that marginal absorption shows in any location. The man who depreciates radiodontic examinations knows little about the practice, or he would be so impressed with the advantages that the limitations would be forgotten. Figs. 1 and 7

illustrate how the line of bone destruction on each surface can be distinguished. Teeth with hopelessly impaired attachment should be removed, not treated to please the vanity of the patient or splinted to obtain a dishonest fee. Except in cases of trauma, teeth requiring splints offer no prospect of being made serviceable and should be eradicated. The x-ray examination is the deciding factor in this diagnosis. Cooperation of the patient is essential to the efficient treatment of periodontoclasia, and a general radiodontic examination is of great assistance in securing it. The psychic effect upon a patient by displaying a set of negatives depicting the bone destruction is more impressive than any description or plea the operator can present. The radiographic record of the actual disintegration of one's self will jolt the most frivolous society butterfly or avaricious financier into full cooperation with the dentist to arrest the progress of disease. This field offers ample opportunity to serve your patients in the legitimate practice of dentistry without usurping radiotherapy.

Focal Inspection

Q.—If a fine focused tube is best for dental radiography, how can I focus it and tell when it is just right?

A.—An x-ray tube is "focused" during the process of manufacture and cannot be changed without returning to the factory for readjustment of the parts and repumping. The term "focus" in relation to tubes is misleading, as x-rays cannot be focused, although experimentally they may be refracted. A fine focus tube is one in which the cathode stream is concentrated upon a small area of the target, and the source of radiation is limited to that area. With other factors constant, a small focal spot produces an image which is sharper in detail and more nearly the true size of the object than would a large focal spot. There is no standard gauge for focal spots but those less than 5 mm. in diameter would generally be considered fine; those from 5 mm. to 8 mm., medium; and those over 8 mm., broad.

After a tube has been used for a time the target will show a marking from the impact of the cathode stream which is the approximate size of the focal spot. An accurate method of determining the size of the focal spot is to interpose a sheet of lead with a pinhole equidistant from the target and film, and radiograph the source of the rays. The lead need not be more than $\frac{1}{16}$ of an inch thick, the pinhole should be the size of a No. 10 needle, and the sides of the opening slightly reamed to remove irregular margins. If the lead is placed about 12 inches from the target and film and an exposure of 10 seconds made, any wavering of the focal spot will be registered. A striking illustration of the effect of different focal spots may be shown by radiographing a wire or a wire screen suspended half way between the target and film.

The demand for perfect intraoral radiography indicates the finest focal spot practicable, which is about 2 mm. for 10 ma.; 3 mm. for 20 ma.; and 4 mm. for 30 ma. The target will be fused by a focal spot smaller than the above proportions, unless short interrupted exposures are used to permit the

dissipation of heat. In ordering tubes the size of the focal spot and the milliamperage used should be specified and proved by test before acceptance. Tube manufacturers are disinclined to supply fine focus tubes because the

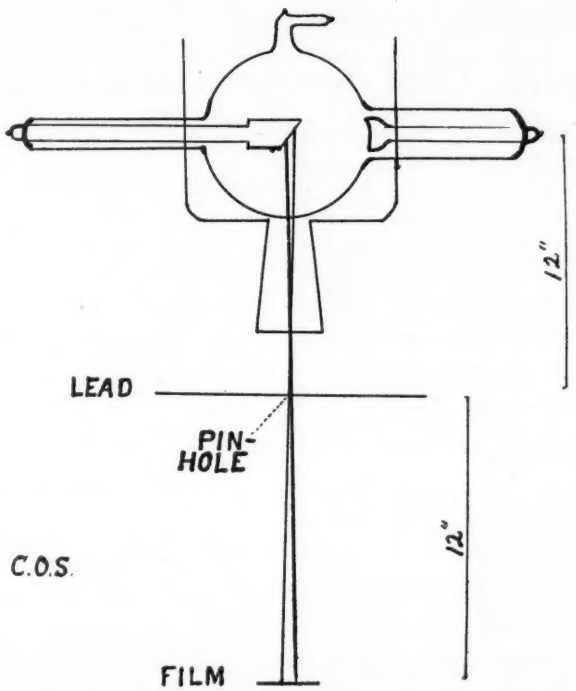

Fig. 8.—A method of radiographing the focal spot.

Fig. 9.—Wire test of a fine and a medium focal spot.

difficulty in adjusting a fine focus limits the production, and improper use of such tubes is likely to cause complaint. Know the type of tube suitable for your work, insist upon getting it, and do not abuse it.

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EDITORIALS

A Plea for the Proper Use of the Soldered Lingual Wire in the Treatment of Distoclusion

THE treatment of distoclusion cases has always been more or less of a problem to a number of men practicing orthodontics. This is proved by the fact that the last meeting of the American Society of Orthodontists devoted a large amount of time to distoclusion cases in spite of the fact that this type of malocclusion has been known for many years and has been successfully treated by many. If you would take the opinion of a number of men who have spent years in the practice of orthodontics you would find exactly two extremes in regard to this type of deformity. There would be some who claim that such types of malocclusion are easily and satisfactorily treated

while there would probably be equally as many who consider them the most difficult and extremely unpromising.

Just why this great difference of opinion should exist is unknown to us, but probably it is the result of different technical procedures in the treatment of these deformities. It has been our privilege to see a great many cases from the practice of various men and we have often been impressed by the fact that the treatment, as it was progressing, would indicate that the operator was not exactly familiar with the mechanical technic he was employing. We know of no type of malocclusion in which the plan of treatment has been more satisfactorily worked out than in distoclusion cases. This is equally true with that type characterized by labioversion of the premaxillary incisors and also those cases in which the premaxillary incisors occupy positions of linguoversion.

These cases have also been satisfactorily treated with both fixed and removable appliances and results have been accomplished by using a combination of the labial and lingual appliance as suggested by Dr. Lourie several years ago. In fact, since Dr. Lourie brought forward the use of the soldered lingual wire in conjunction with the high labial appliance a great many men have been using that form of technic. To our mind, that style of appliance as described by Dr. Lourie, and as published in the fourth edition of "Practical Orthodontia," is one of the most satisfactory, if properly employed. However, the extreme simplicity of the soldered lingual alignment wire when applied to the mandibular teeth in distoclusion cases has resulted in its improper use.

In our practice, the soldered lingual alignment wire on the mandibular teeth is extremely valuable. In order to accomplish the desired result it must be used with the proper knowledge of wire stretching and the case must be under constant observation. We have found several men have become careless in the use of the soldered lingual alignment wire in distoclusion cases when applied to the mandibular teeth and are not pinching the lingual wire sufficiently to get the proper expansion. In conjunction with the above appliance on the mandibular arch, some use a labial appliance on the maxillary teeth and get much more rapid expansion of the maxillary arch than they do of the mandibular arch. They then apply intermaxillary rubbers and bring the mandibular arch forward before having the proper amount of expansion.

Such a procedure results in the case's being about one-half completed, and there it remains to a certain extent stationary so far as further improvement is concerned.

The whole fault lies in the improper use of the soldered lingual alignment wire, which when once adjusted, is a very neat and comfortable appliance and the operator feels secure because of the inconvenience to the patient. The appliance creates very little discomfort and the operator fails to stretch the wire enough to get the sufficient expansion of the mandibular arch. If such a technic is followed the soldered lingual wire becomes an objectionable appliance and the result would be much better if a labial appliance had been placed on the mandibular teeth as well as on the maxillary teeth.

Our belief, therefore, is if you are going to use a soldered lingual align-

ment wire on the mandibular arch, remember that it must be pinched to get the proper expansion and cannot be placed on the teeth and allowed to remain without proper alignment, as we have seen in several instances.

The soldered lingual alignment wire is one of the most valuable in the treatment of distoclusion cases because it lends itself nicely towards changing the plane of occlusion and also to the use of intermaxillary rubbers and is very little of an inconvenience to the patient. However, all these valuable points may be rendered null and void by the fact that it can be misused by the individual who does not pay the proper attention to the wire stretching as to get proper expansion.

Teaching Orthodontia in Dental Schools

WITHIN the last few years the subject of orthodontia and the method of teaching it has received considerable discussion from men who have been paying particular attention to the subject.

Owing to the fact that orthodontia is a distinct specialty of dentistry and so recognized by practically the entire profession, the question naturally arises as to how much orthodontia should be taught dental students, and the best method of teaching it. For a number of years a great many schools did not have a separate department of orthodontia. In fact some of the schools still teach the subject under some other chair. We believe that orthodontia is important enough to have a special department, and the subject is important enough even from the standpoint of the dental students, to require more attention than has been given to it in the past.

From experience in different dental schools and in postgraduate work, we find that practically all dental colleges do not teach enough dental anatomy, so far as tooth form as related to function and occlusion is concerned. When students begin to study the anatomy of the teeth as related to orthodontia, we find they must devote a great amount of time to reviewing dental anatomy in order to be able to grasp the meaning of tooth forms as related to functions and their bearing on the occlusion. Therefore, we really believe that if the departments of dental anatomy would devote more time to the teaching of dental anatomy, as outlined above, the departments of orthodontia would be able to teach more orthodontia to undergraduate students than they have been able to do in times past. We believe, however, that the teaching of orthodontia should extend over a period of two years. Whether it is given in the sophomore and junior years, or the junior and senior years does not make very much difference, so far as we can see.

The first year of instruction in orthodontia to undergraduate students should consist of a study of the anatomy of the teeth, including tooth forms, as related to functions, the review of the normal occlusion and should include the study of the positions of malocclusion, classification of arch relations, and a study of jaw deformities. It is also presumed that before the student takes

up the study of orthodontia as outlined in the above paragraphs, that they have had comparative dental anatomy which also has a great bearing upon the study of occlusion.

We believe a study of normal occlusion and malocclusion as outlined will require one year's work in a lecture course of one hour a week. After the above subject has been mastered in one year's instruction, the next year the student is ready to continue his study of the etiology of malocclusion, diagnosis and prognosis, consideration of mechanical principles as related to regulating appliances which will include anchorage, different designs of appliances, and an analysis of them. With the consideration of appliances the time should be devoted more to a study of general mechanical principles, than to the technical instructions and applications of the appliances. From experience, we know it is impossible to teach the detail of appliance construction to undergraduate students by devoting but one lecture hour a week, extending over a period of one year.

Treatment of malocclusion should be considered also in a general way. Different types of malocclusion which may be treated by the use of different types of appliances should be explained. The consideration of treatment is with the idea of giving the student a general knowledge of the subject, rather than to expect him to successfully handle the cases in his practice other than the simpler forms of malocclusion.

In regard to a technical course, we believe that the technical work for the first orthodontic year should include the taking of plaster of paris impressions, putting them together, the proper finishing of the impression, separating and trimming the cast. We have found that the average dentist does not take even a fair plaster of paris impression of a case of malocclusion. The cast that he produces from that impression has a lower average than the impression itself. Therefore, the importance of plaster of paris impressions as a part of orthodontic technic is not so much in relation to its use in the correction of malocclusion in the life of the dental student, as to teach him to work plaster. Modeling compound impressions should also be taken, as the student gets few good modeling compound impressions when teeth are present.

The proper manipulation of plaster is something that the average student does not learn. While it seems that the taking of the plaster impression and the construction of the orthodontic models may seem to be a very small technic, nevertheless, if it is properly taught, it will probably require more time than could be given to the subject in the average dental school. Therefore, if this technic was followed out, it would be necessary to rearrange a good deal of the other work to give the proper time to this subject. We make this statement because of experience with undergraduate students in an effort to teach them plaster impression work, and also because we have found in postgraduate work that it takes about 108 hours to teach impression-taking and cast-making to postgraduate students. If it takes that length of time with postgraduate students, one cannot expect undergraduates to learn it in much less time, therefore, where are we going to get the 100 hours for

technical work, if it is to be taught properly? We believe it should have consideration because of the importance it will have in relation to prosthetic dentistry, crown and bridge work, or anything which requires a correct impression, and an equally good cast. We are not finding fault with the prosthetic department, but every one will admit that a good impression and a good cast as produced in prosthetic dentistry, or crown and bridge work, is the exception, and not the rule.

In regard to a technical course which includes appliance-making or the construction of appliances, we believe that should be taught in the next year and should consist of the students soldering wire so as to make straight end joints and right-angle joints and other designs which the teacher may suggest. The plain bands should be made over artificial stone models with every other tooth carefully carved to anatomical form. This brings into use the knowledge of tooth forms, and develops skill in the manipulation of the cast.

We do not believe that the drawing of wire, the cutting of threads and the making of nuts should be a part of the technical course because this is something that is not done in the practice of orthodontia today.

The next thing to consider in teaching orthodontia, is the orthodontic clinic which is a subject that also has not been satisfactorily settled in the minds of many men. Some schools actually have their senior students treat two cases of malocclusion during their school year. The object of the clinic in dental schools should be to teach the students what can be accomplished in that branch, and what should be accomplished. Where the senior student treats two cases of malocclusion he generally sees those two cases and no others. One or both of the cases has been passed to him from the preceding class. He knows practically nothing of the cases that have been given to him, in relation to the condition before the treatment was begun, and consequently does not have a complete knowledge of the case. If the senior student begins the treatment of the case of malocclusion, the average case is not finished during the period of time he is in school and is therefore, passed on to the next class. This plan has been very undesirable because comparatively few finished results were obtained during the time the student had the case under treatment. One of the greatest disadvantages to this plan is that the senior class graduates during the summer and the orthodontic patients are without care because the orthodontic department does not have sufficient men working through the summer to give them the proper treatment. Consequently, the cases relapse and when the school opens again several weeks' treatment must be given before the case is again progressing along proper lines.

We believe that correction of a case of malocclusion is too technical an operation to be handled successfully by a senior student who has had no previous experience in the treatment of malocclusion. We can see no more reason that students should attempt to correct cases of malocclusion during their senior year than that medical students should be expected to perform all sorts of surgical operations during their senior year. The orthodontic clinic and all the cases treated in that clinic, in our opinion, should be handled by

a group of men who have special orthodontic training and are able to treat the case correctly. The class should be divided into sections to observe the treatment in the orthodontic clinics, the same as students of medicine witness surgical operations. Under this plan, the dental student would see a large number of cases in different stages of treatment with different types of appliances and each appliance properly adjusted which would give him a better knowledge of the possibilities of orthodontics than he could possibly obtain by attempting to treat two cases himself. Furthermore, the orthodontic clinical staff should have sufficient trained men to care for these cases, not only during the school year, but also through the summer months.

The successful teaching of orthodontia depends upon an understanding of the tissues supporting the teeth. The proper teaching of orthodontia along the lines outlined will be found to produce a beneficial effect on all subjects and will greatly repay all the time given to it.

The American Illustrated Medical Dictionary*

THE American Illustrated Medical Dictionary edited by Dr. W. A. Newman Dorland has always been one of the most important books in the library.

The eleventh edition, revised and enlarged, is just from the press and contains all of the good features found in other editions with the addition of new terms and words which have come into use recently. It practically covers the field of Surgery, Dentistry, Pharmacy, Chemistry, Veterinary, Science, Nursing, Biology, and kindred branches, and consists of a large number of tables that have always been of value to the student.

The present edition contains 1229 pages with 338 illustrations, 141 of which are done in colors. There is no book which is more important to a modern medical library than the eleventh edition of this dictionary.

*Published by W. B. Saunders Company, Philadelphia and London.

ORTHODONTIC NEWS AND NOTES

The editors desire to make this department a permanent feature of the Journal, but in order to do so must have the full support of the orthodontic profession throughout the country. We would deem it a great favor if our subscribers and readers would send in such announcements as might be of interest to the profession.

Pacific Coast Society of Orthodontists

A cordial invitation is extended to all interested in orthodontia to attend the next Annual Meeting of the Pacific Coast Society of Orthodontists, which will be held in Los Angeles, California, July 13, 14, 15, 1922. Those who contemplate being in attendance are requested to make known their intention to the Secretary as soon as possible. Charles G. Mann, President, Seattle, Washington. Carl O. Engstrom, Secy.-Treas., Box 1070, Sacramento, Calif.

Southwestern Society of Orthodontists

The Second Annual Session of the Southwestern Society of Orthodontists was held in Oklahoma City, Okla., Saturday, April 22nd, Skirvin Hotel. An excellent program, as previously published, was enjoyed. Officers elected for the new year were, Dr. W. E. Flesher, Oklahoma City, President; Dr. T. G. Duckworth, San Antonio, Texas, Pres. Elect; Dr. P. G. Spencer, Waco, Texas, Secy.-Treas. Board of Censors, Dr. Oscar Busby, Dallas, Texas, Dr. T. G. Duckworth, San Antonio, Texas, Dr. W. T. Chapman, El Paso, Texas.

It was recommended and voted that Kansas and Kansas City, Mo., be included in the territory covered by this Society. Applications for membership from all Orthodontists in this territory will be welcomed.

Meeting of the National Alumni Chapter of The Psi Omega Fraternity

The National Alumni Chapter of the Psi Omega Fraternity will hold its next meeting on Monday, July 17, at the Clark Hotel, Los Angeles, California. The Chapter will be called to order at 10 A.M. There will be an afternoon meeting also and an informal banquet at 8 P.M. at the Los Angeles

Athletic Club. A large attendance is desired. Every Psi Omega should register immediately on arrival in Los Angeles. Headquarters will be maintained during the National Meeting at both the Ambassador and the Clark Hotels.—*Max Wassman, Jr., Grandmaster National Alumni Chapter.*

European Orthodontia Society

The next meeting of the European Orthodontia Society will take place on July 26th and 27th, at No. 11 Chandos Street, London, in the rooms of the British Medical Society.

Several known orthodontists from America expect to be present and offer papers or clinics: Drs. Hawley, Mershon, Fisher. Several members will also give papers. Among the titles already announced are:

Dr. C. A. Hawley, of Washington, The principles and art of retention.
Dr. C. Johanson, of Helsingfors, Some cases of traumatic lesion of the deciduous denture, and its bearing on the permanent jaw and teeth.
Dr. C. Johanson, Two corrected cases of impacted teeth.
Dr. G. Lind, of Amsterdam, Remineralization of the teeth.

Among the demonstrations and clinics are:

Dr. C. A. Hawley, The manipulation of the Ribbon Arch.
Dr. G. Lind, Remineralization.
Dr. J. T. Quintero, Sweating bands for orthodontic purposes.

Complete programs will be forwarded later. Those interested are cordially invited to attend the meeting; further information may be obtained from the undersigned secretary.—*Dr. James T. Quintero, Secretary.*

Meeting of the Eastern Association of Graduates of the Angle School of Orthodontia

The Thirteenth Annual Meeting of the Eastern Association of Graduates of the Angle School of Orthodontia will be held at the Hotel Vanderbilt, New York City, on May 22 and 23.

The following program will be presented:

Monday, May 22

System Applied to Practice.
Dr. S. Merrill Weeks, Philadelphia, Pa.

Studies in Endocrinology.
Dr. George A. Bates, Professor of Histology, Tuft's Dental School, Boston, Mass.

Orthodontic Treatment of Cleft Palate, Together with a Report on Some Cases.
Dr. Harry E. Kelsey, Baltimore, Md.

The Field of Muscle Training in Orthopedic Surgery.
Dr. Armitage Whitman, Assistant Surgeon of the Hospital for Ruptured and Crippled, New York.

Business Meeting and Election of Officers.

Nominations for Officers, 1922-1923.

President—Dr. Ira B. Stilson;

Vice-President—Dr. Alfred M. Desnoes;

Secretary—Dr. E. Santley Butler;

Treasurer—Dr. Walter S. Watson.

Dinner at the Hotel Vanderbilt.
Ladies invited.

The dinner will be served promptly so that ample time will be given those who wish to leave for the theatre.

Chairman of Dinner Committee,
Dr. Alfred M. Desnoes.

Tuesday, May 23

A Consideration of Some of the Properties of Metals.

Dr. Frederic T. Murlless, Jr., Hartford, Conn.

A Review of Some of the Recent Literature on the Endocrine Glands.

Dr. Albert W. Crosby, New Haven, Conn.

President's Address.

Dr. C. A. Hawley, Washington, D. C.

Clinics:

Open Bite Cases.

Dr. A. LeRoy Johnson, Boston, Mass.

Lingual Retainer.

Dr. Alfred M. Desnoes, New York City.

(a) Auxiliaries for Root Movement on the Lourie High Labial Arch and the Lingual Arch.

(b) Sliding Lingual Arches for Root Development.

Dr. John Mills, Toronto, Canada.

Some Instruments I have Found Useful in My Practice.

Dr. J. Lowe Young, New York City.

Some Adult Cases.

Dr. Ira B. Stilson, Providence, R. I.

Some Points on Diagnosis and the Selection of Type of Appliances for Treatment.

Dr. George W. Grieve, Toronto, Canada.

A Simple Appliance for Retaining Normal Mesio-distal Relation of Molars.

Dr. Edward L. Mitchell, Indianapolis, Ind.

(a) Orthodontic Limitation in Type of Class One Cases, presenting three or four cases for discussion.

(b) A Failure.

Dr. B. W. Weinberger, New York City.

Subject to be announced.

Dr. William H. Pearson, Norfolk, Va.

The officers for 1921-1922 are as follows: President, Dr. C. A. Hawley, Washington, D. C.; Vice-President, Dr. Ira B. Stilson, Providence, R. I.; Secretary, Dr. E. Santley Butler, New York; Treasurer, Dr. Walter S. Watson, New York City; Executive Committee, Dr. F. C. Kemple, Dr. H. C. Ferris, and Dr. H. A. Pullen; Scientific Committee, Dr. W. S. Watson, Dr. F. S. Casto, and Dr. C. C. Howard.